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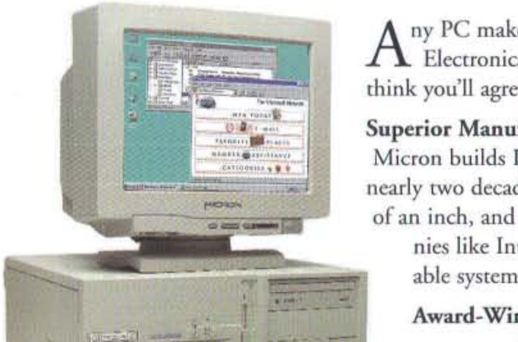

Any PC maker can claim to offer a solution that covers your needs. But at Micron Electronics, we prefer to let our history and our products speak for themselves. We think you'll agree, it's an impressive story.

Superior Manufacturing—A Micron Tradition

Micron builds PCs with a legacy of excellence. Our manufacturing processes grew out of nearly two decades in the semiconductor business, where precision is measured in millionths of an inch, and quality in parts per million. We've built strategic relationships with companies like Intel, Microsoft and Novell. From this solid background, we're forging unbeatable systems you can count on today and tomorrow.

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In the past two years, leading industry publications have applauded Micron PCs with more than 140 awards for product performance, customer service and support. This includes *PC Magazine*'s Best Products and Editors' Choice awards in several categories. Add more than 40 *PC World* Best Buy awards and you've got an impressive technology hall of fame.

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Source: PC World Reliability & Service Monitor, May 20 - November 20, 1995

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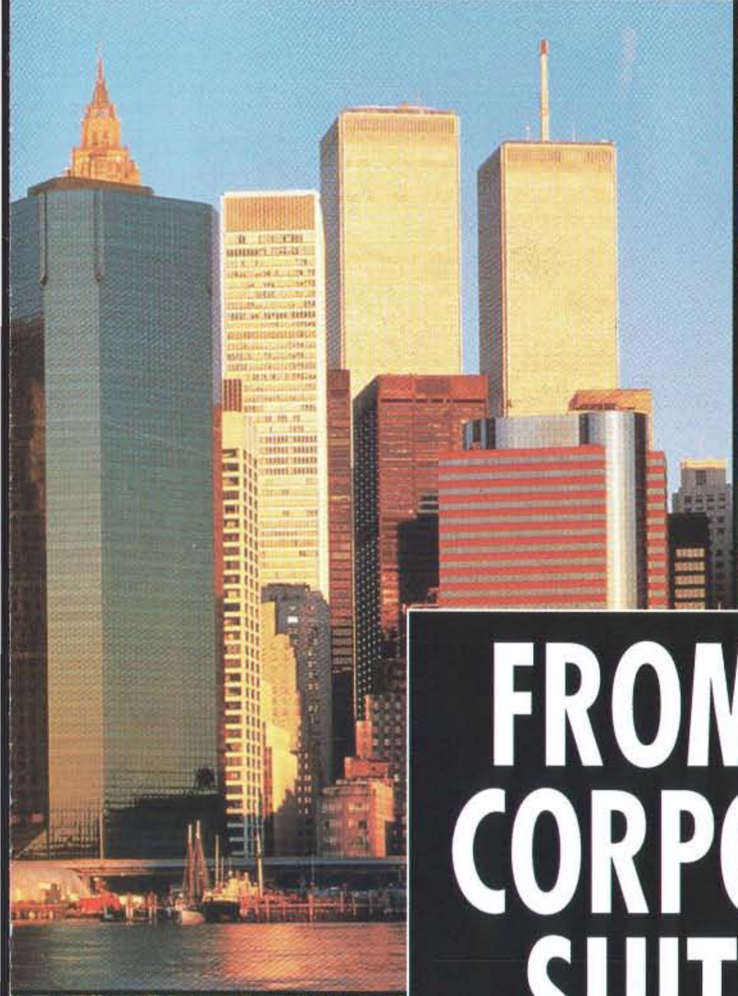

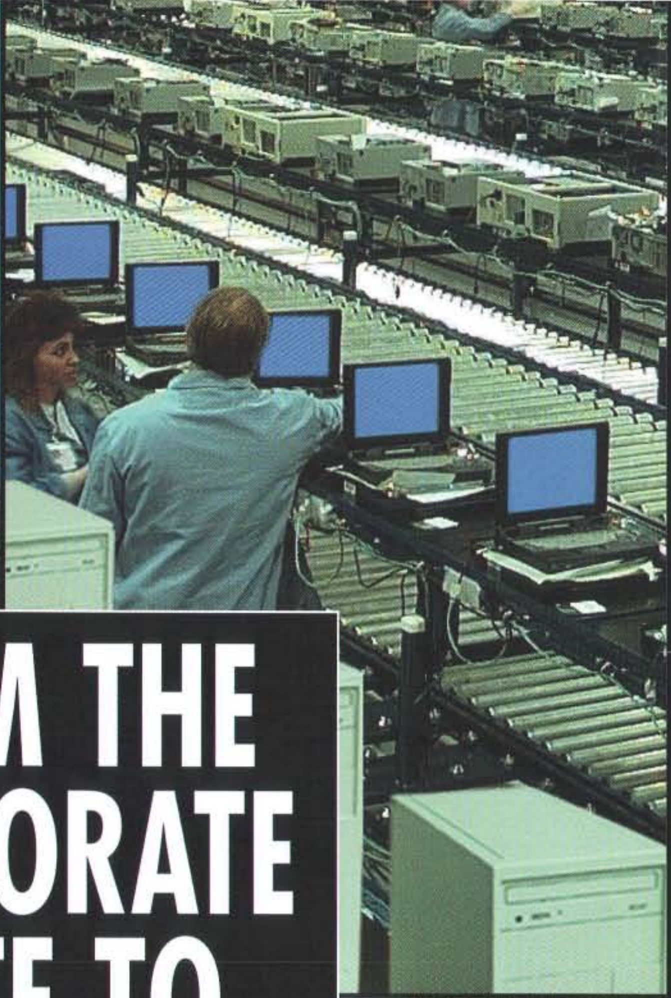

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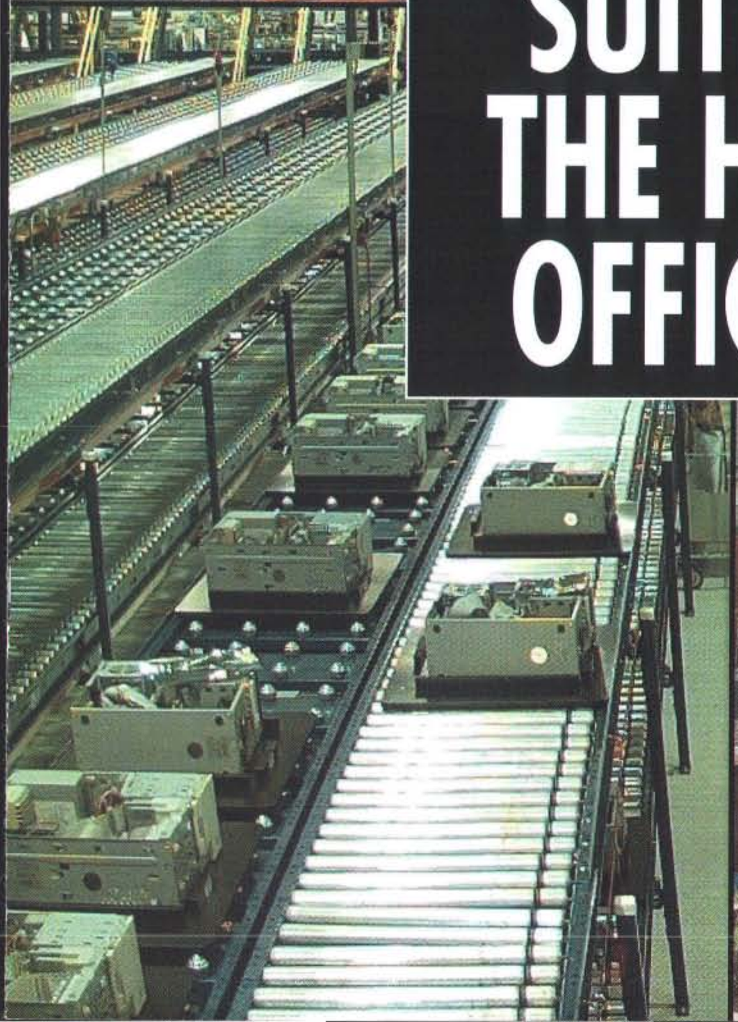

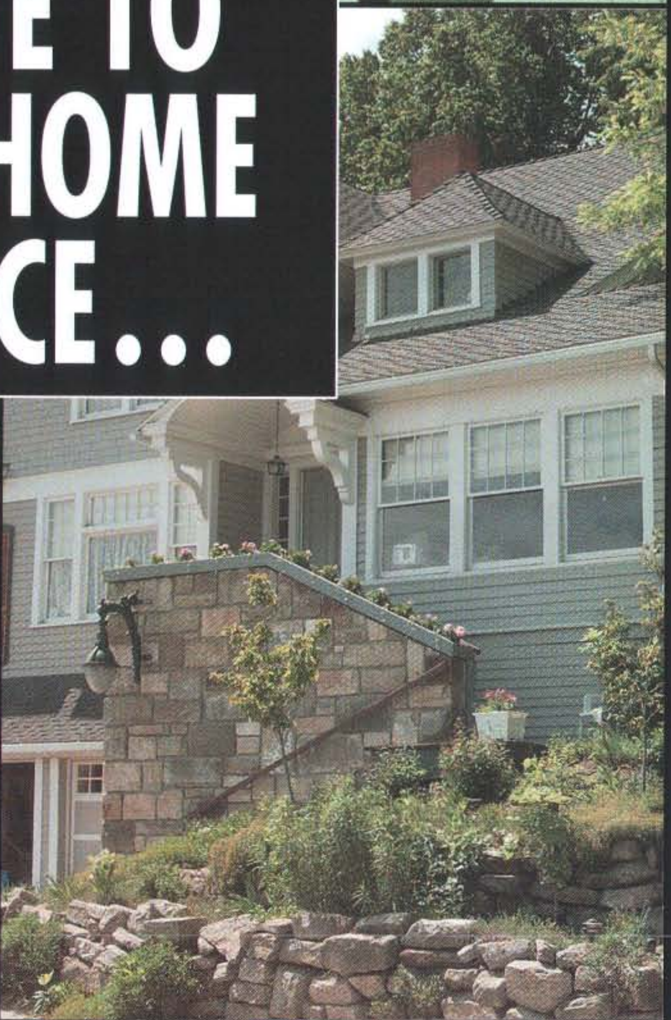

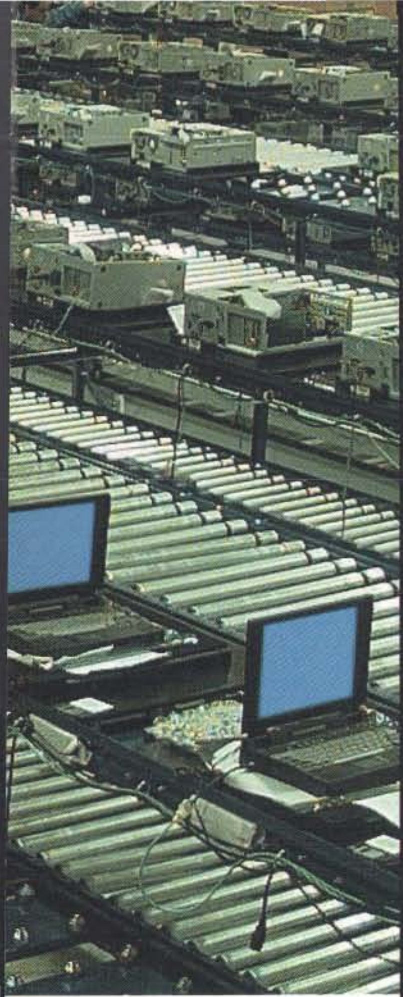

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In June 1996, Micron's Millennia P166 and Millennia P133 won two of three *PC Magazine* Editors' Choice awards.

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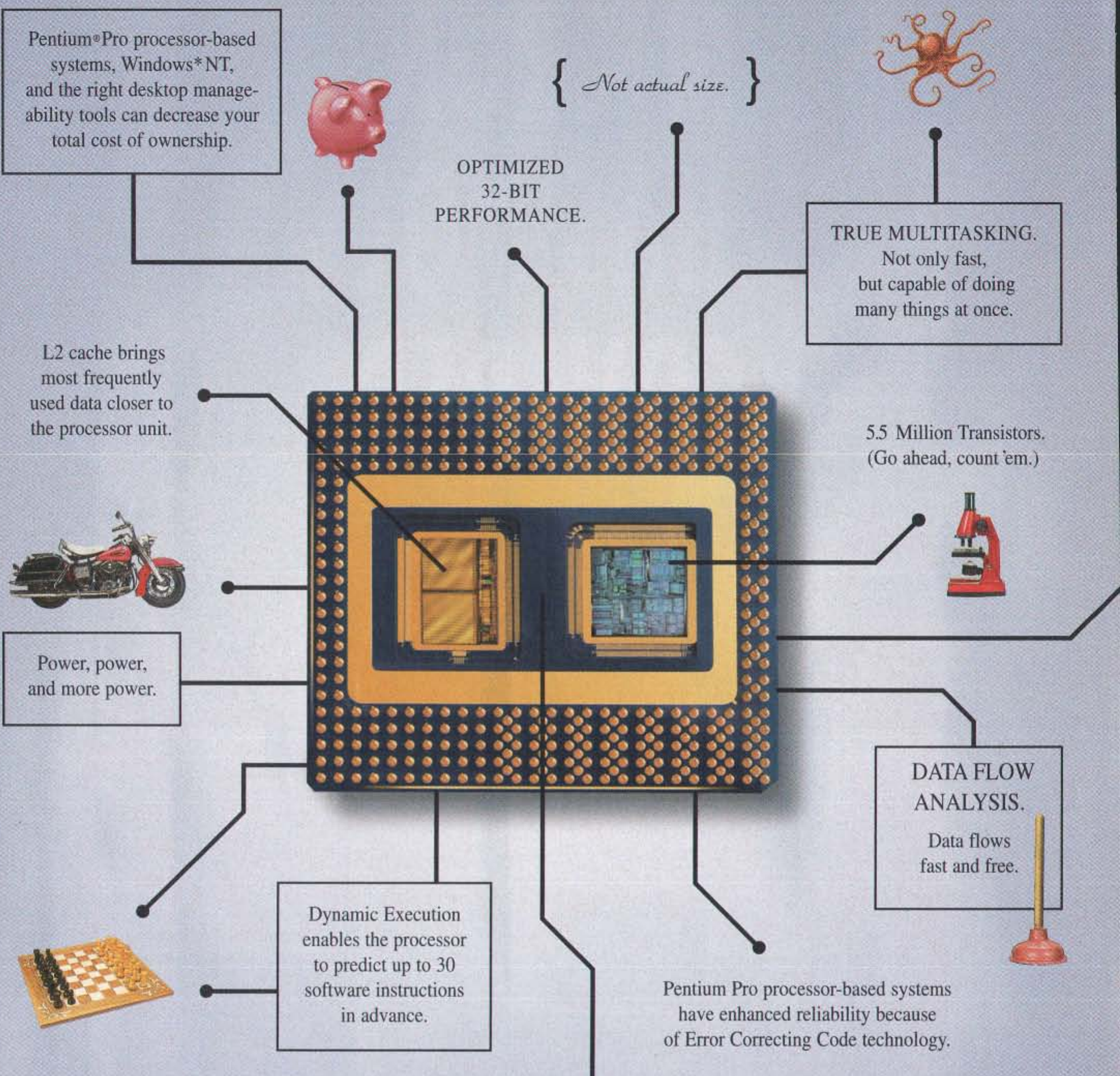

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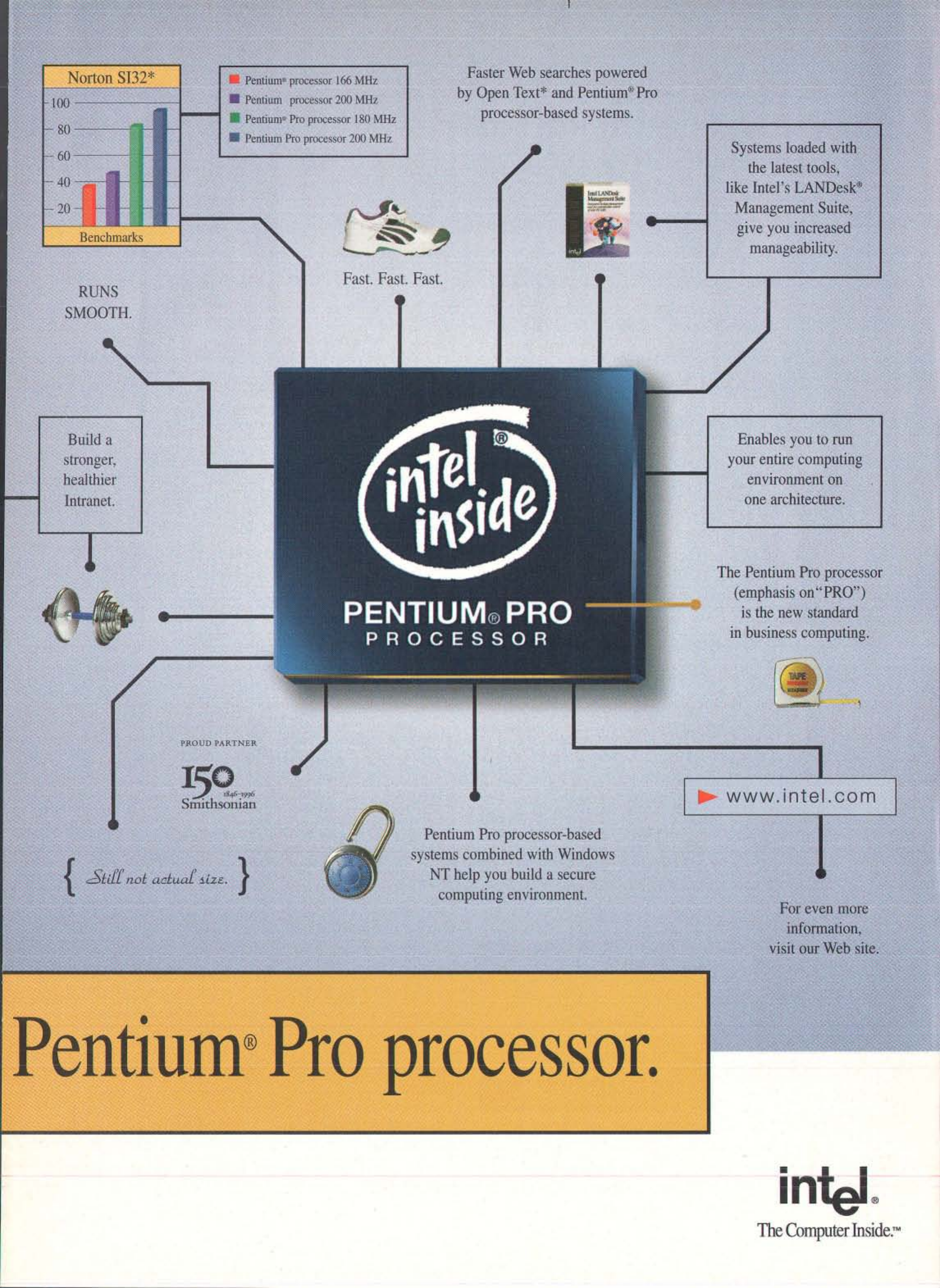

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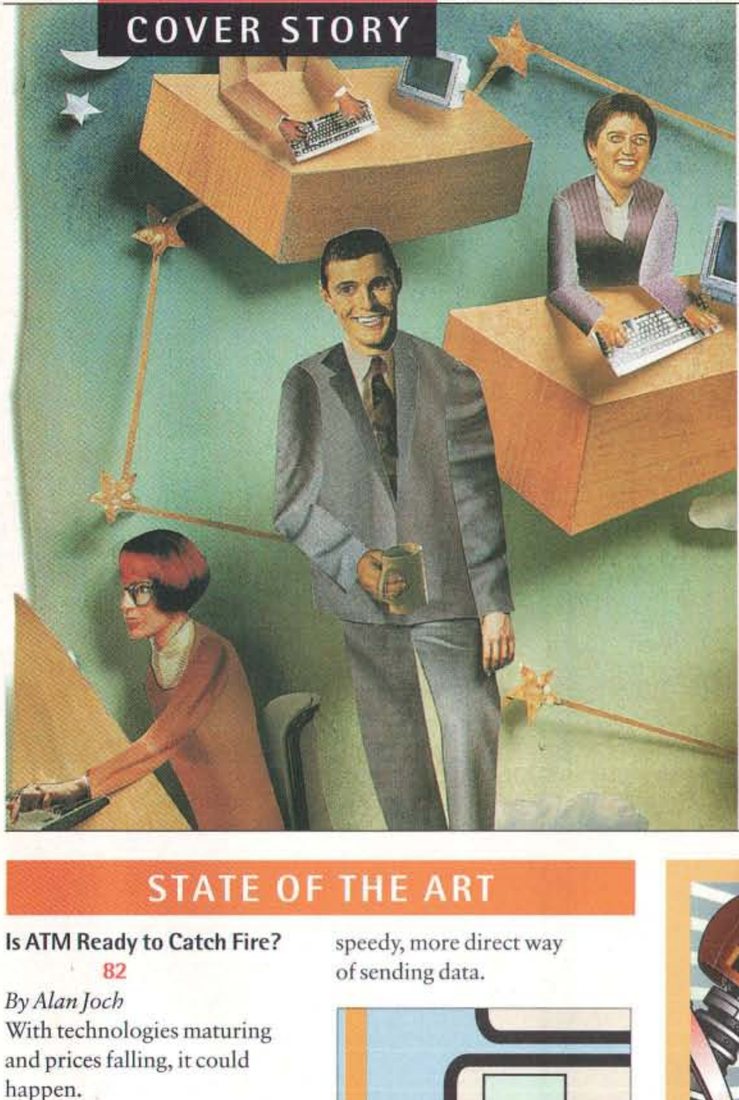

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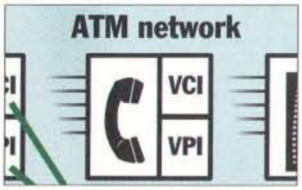

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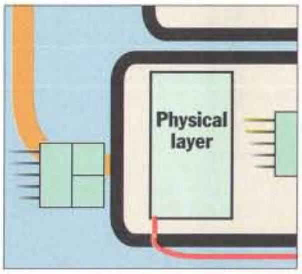

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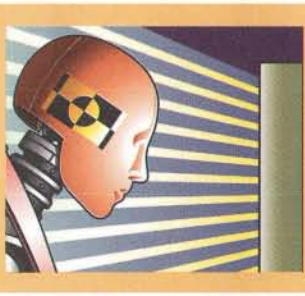

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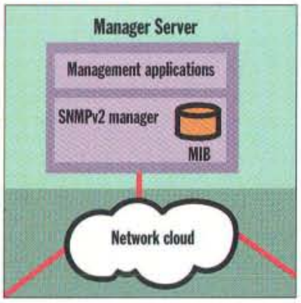

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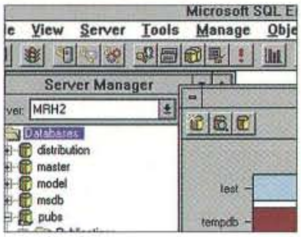

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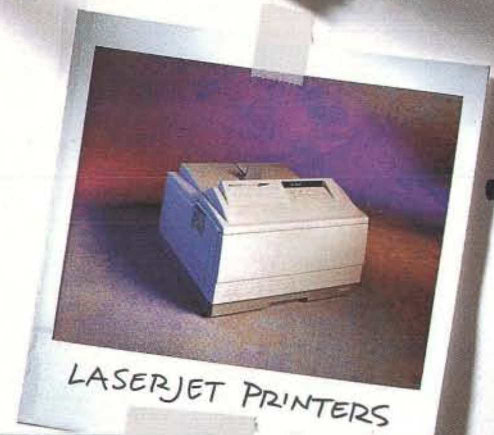
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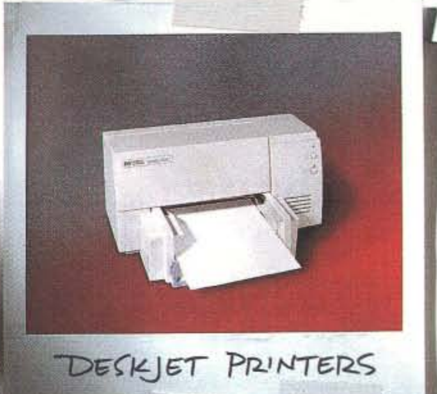
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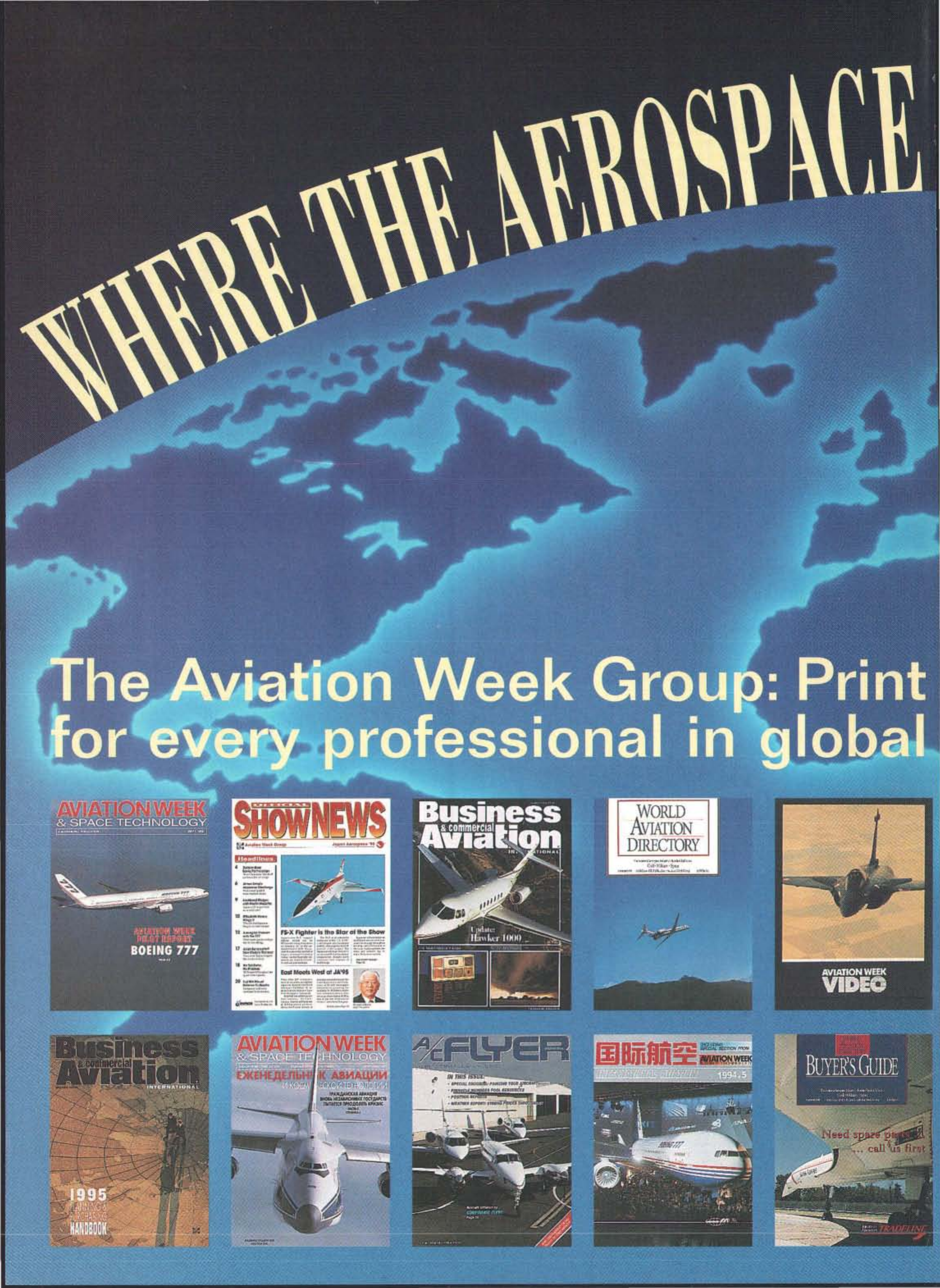
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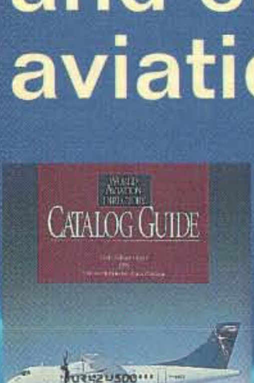

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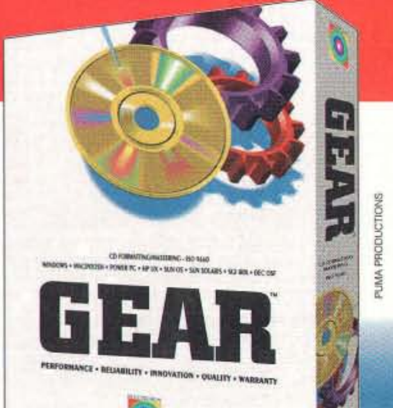

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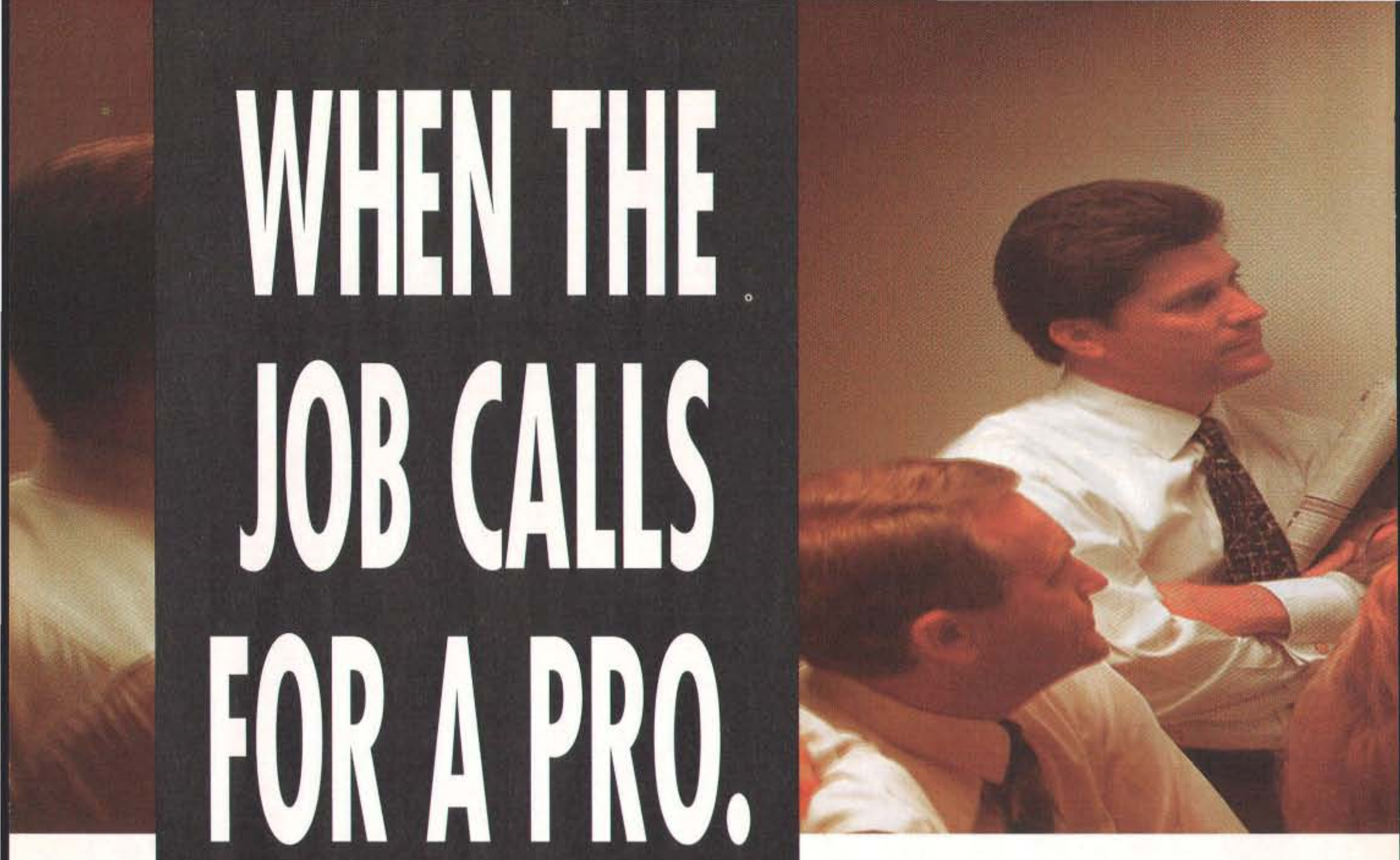

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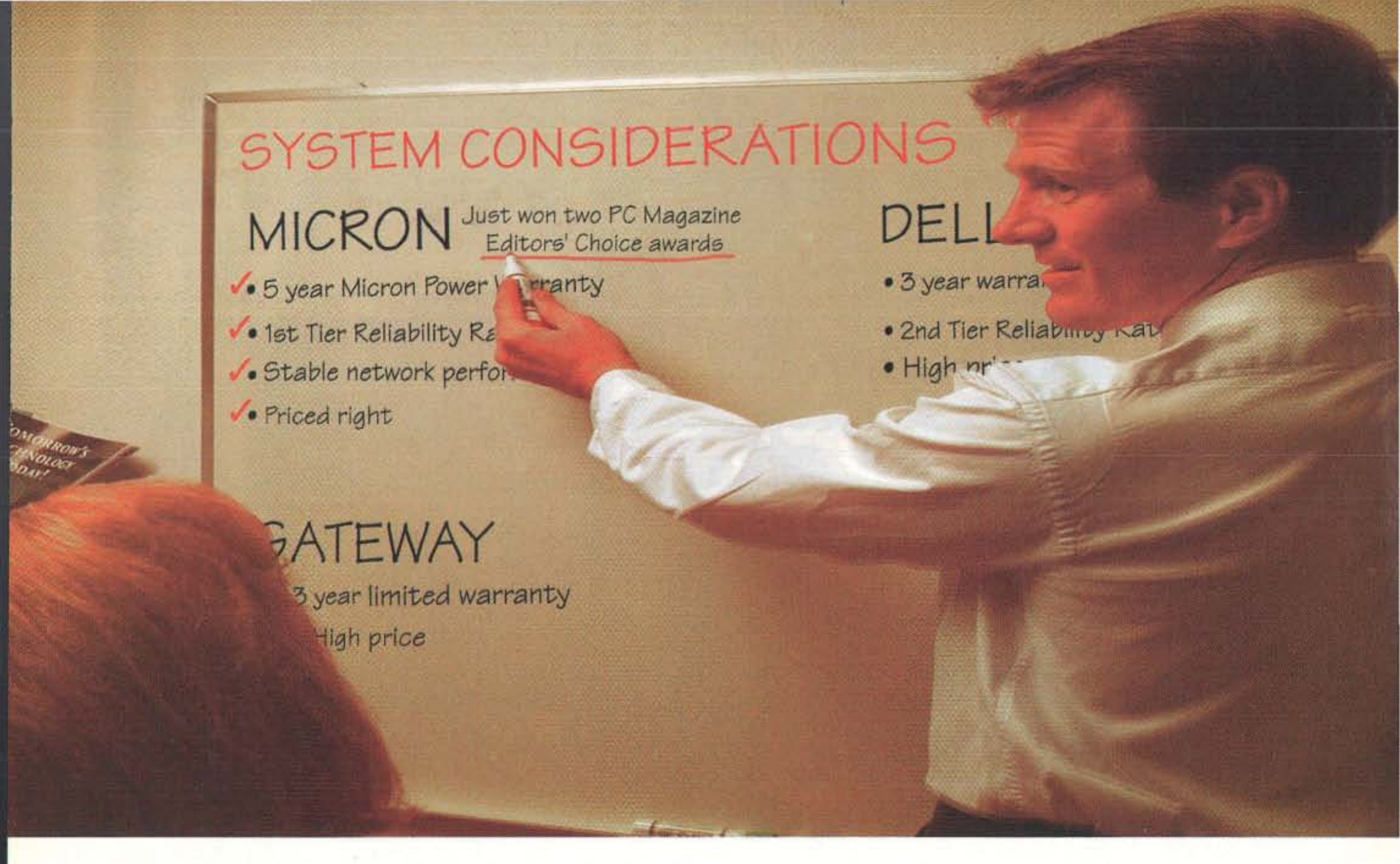
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editorial

Weird, Wacky, and Wonderful

Life's never boring in computing, and it's about to get a whole lot more interesting.

Every few years, the computer industry experiences a collective madness in which Northern California civility gives way to a mentality more typical of Chicago commodities pit bulls. It's shaping up to be one of those years.

Those of us who buy and use computer technology are confronted by a horde of shouting, shoving vendors, all vying for our business. Our whole world is being shaken up. And that's probably a good thing.

After all, it's been relatively calm for a few years. It used to be you bought a Novell LAN, Windows or the Mac OS, somebody's Unix relational database management system (RDBMS), maybe PowerBuilder if you wanted to be really cool, and voilà!—a mainstream client/server computing architecture.

Then this weird technology called the Web kicked in. Build information systems around plain-ASCII text? Program in scripting languages? Sounded pretty primitive compared to database managers, SQL, and C++. But somewhere along the line, the sharpest information-technology (IT) people got a gleam in their eye. This Web technology seemed to address a whole host of problems that client/server computing just hadn't delivered on: portability, flexibility, and location independence.

Remember how client/server computing was supposed to let you shift work between client and server as needed? No MIPS would go unused. However, nearly a decade after client/server first debuted, few tools exist that allow anything like a dynamic repartitioning of an application; none that I know of does it in real time or automatically. And even the best application splitters work only within their own confines. Try taking a complex application system developed in C++, PowerBuilder, and Visual Basic and start shifting functions around. Can't get there from here, as they say in Maine.

The wacky part is, this new Webbed world can get you at least partway there. Start with a plain-vanilla browser. It'll run on the thinnest client platforms, even the much-heralded Web PC. Need a fatter one? Add plug-ins, Java, or ActiveX applets. Want a totally obese client? Put Windows 95 underneath.

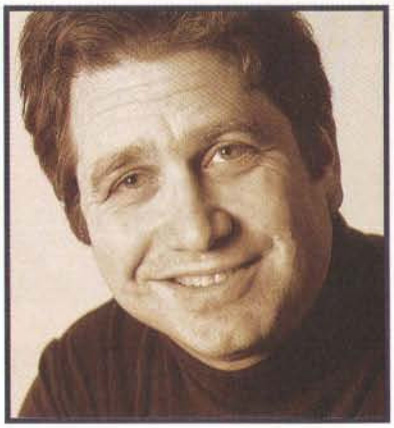
The wonderful part is, you can figure out all this for yourself. The whole fat-server/fat-client debate has gone from a strategic one to a tactical one. There's no one right way to divide the work between server and client, despite the marketectural pretensions of our software pit-bull traders.

The whole fat-server/fat-client debate has gone from a strategic one to a tactical one.

Will embracing this flexibility and diversity bring you closer to that holy grail of application systems that automatically reconfigures itself for maximum performance and balanced capacity utilization? No; the best you can do is achieve a static load balance with this new toolkit of architectures.

For now, that's as good as it's going to get. If we can just avoid getting sucked into a whirlpool of false pronouncements that a particular programming paradigm is the right one, we now have the tools to get halfway toward that holy grail.

When do we get to the finish line? Ironically, we'll have to wait until client/server computing withers away. Its emerging successor, distributed object computing, replaces monolithic blocks of code with many smaller objects that cooperate to form a working application. The objects can move around and be moved around by an intelligent networked OS.



If it works (and that's a big *if*), it will be a big step forward. Meanwhile, the newfound flexibility of browser clients, server farms, and components that are their own middleware should keep us busy learning and marveling for the next few years.

Mark Schlack

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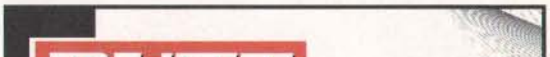
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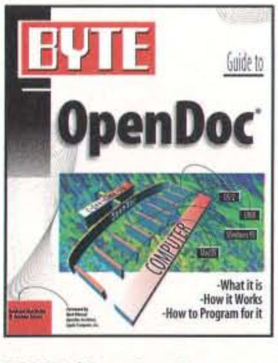

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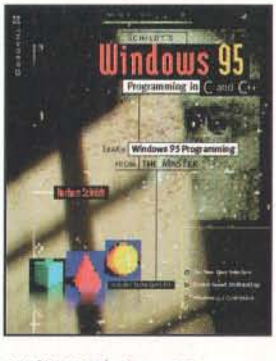

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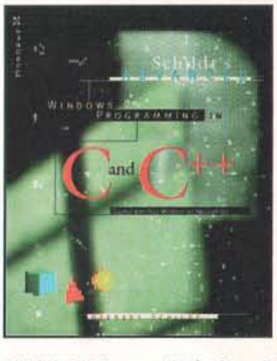

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The New BYTE

I really like BYTE's new format. Your use of pastel colors makes the magazine seem less stuffy and more approachable, yet you retain the same high quality in your in-depth coverage of state-of-the-art technology. My congratulations to your layout designers.
Frank Palmer
FPalmer@msn.com

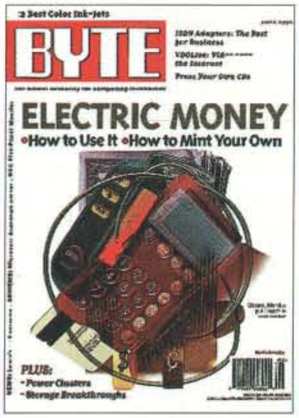
I've just read the June 1996 issue and wish you hadn't made the format switch. The script-like font used on the cover and for article headlines and subheadlines is difficult to read and does not present a high-tech feel. The new graphics are even worse. They make it appear that BYTE is dumbing down to reach a less technically oriented audience. I don't doubt that the same level of material is present, but I think it's being delivered in the spoon-fed manner of magazines for novices. Please reconsider your new look and make sure it's in keeping with your audience.
Alan T. McDonald
atmcdona@lanmail.rmc.com

We've had some feedback from readers about the new typefaces, and it's clear that we've gone too small and too scripty in a few instances. We're fixing those readability problems. To readers who are concerned that we're dumbing-down BYTE, I can only say, watch us. We're absolutely not dumbing anything down. I have received clear and consistent feedback from computer professionals over the last few years that they have too much information to assimilate in too little time. Often, they have to quickly come up to speed on areas outside their specialties. Our goal is to help you access and assimilate complex technical information in the shortest possible amount of time. Our new diagram style is intended to be simple—not simplistic—bold, and dynamic. We think that in time you'll appreciate that approach.—Mark Schlack, editor in chief

Get CORBA

After reading through several issues of BYTE, I have become very interested in the Common Object Request Broker Architecture (CORBA). Your articles mention the 440 companies that subscribe to this standard; however, nowhere is any mention made of how others can obtain a copy of the latest CORBA specifications.
Roy Weston
rweston@galileo.co.uk

You can find information and several links, including one to the CORBA 2.0 specification, at http://www.omg.org/, which is the home page of the Object Management Group (OMG). The Advanced Computing Laboratory at the Los Alamos National Laboratory also maintains a CORBA and OMG information resources page (see http://www.acl.lanl.gov/CORBA/), which includes many technical papers as well as links to several related consortium, company, and project sites.—Eds.



Unix vs. NT—and OS/2

I was displeased at not seeing OS/2 included in your article "Unix vs. NT" (May). I believe there are more LAN Servers out there than NT servers—your own pie charts show what a small fraction of the market NT currently has, despite all the predictions for its glorious future. However, OS/2 didn't even rate a text box.
Geoffrey Snyder
gsnyder@gsnyder.seanet.com

This was strictly a story about Unix and Windows NT. In addition to not bringing OS/2 into the discussion, we didn't write about NetWare, the Mac OS, the many different versions of Unix, or any other OSes. We cover all those OSes regularly in BYTE; in fact, we're the only computer magazine to do so. In this case, we decided to focus on Windows NT—because of its status as a newcomer—and compare it to Unix as a representative of the old guard. No slight to other OSes was intended. —Tom R. Halfhill, senior editor

Porting Unix

I use Unix extensively in a scientific research environment, but looking at the price of new NT machines—and especially NT software—often makes me think about switching. But I have invested years in developing code in a Unix envi-

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ronment. How difficult will it be to port this code to NT? Will I be able to use Unix's powerful shell and great tools in NT? Alternatively, does NT have comparable text-processing tools? Will I have to learn a new editor, a new way of managing files, and so forth? Are there products that give NT a Unix-like flavor and help with the porting process? I wish answers to these questions had been included in the article.

Mark Gerstein
Structural Biology Dept.
Stanford University
mbg@hyper.stanford.edu

Unfortunately, those questions were outside the intended scope of the article. That said, there are a number of alternatives. The Hamilton C shell port is available from Hamilton Laboratories (Sudbury, MA; hamilton@bix.com). Mortice Kern Systems (http://www.mks.com/) sells a popular Toolkit for NT. Datafocus (http://www.datafocus.com/) offers the Nutcracker family of products. Softway Systems (http://www.softway.com/) recently released OpenNT, and GNU tools are also available from various sources.

A search of the Web will turn up other resources. One place to start is the Windows NT Links page at http://www.unitek.com/pages/ntlinks.htm. If it's primarily a matter of cost, don't forget inexpensive Unix variants, such as Linux and FreeBSD.—Eds.

Use at Your Own Risk

Besides being interesting in itself, Microsoft's Power Toys suite of utilities ("Underground Upgrades for Windows 95," April) shows a design flaw in the localization model of Win 95. Since the suite's installation procedure did not recognize the standard folder names of my Italian version, it created a new, parallel, English folder hierarchy—"StartUp" instead of "Esecuzione automatica" and "Accessories/Multimedia" instead of "Accessori/Multimedia." It may cost companies substantial money, both in support and wasted employee time, to help their Win 95 users remove the clutter from their desktops.

Paolo Amoroso
amoroso@mclink.it

Microsoft is quick to point out that the Power Toys—and the newer Kernel Toys—are not part of Win 95 and are unsupported. At the present time, they exist only in an English-language version; you won't find them in any international area on Microsoft's Web site. While this may not constitute a localization flaw in Win 95 itself, it's definitely something that users of international versions should consider.—Eds.

No Fear with SGML

Many of the work-flow problems you identified in "Work Flow Without Fear" (April) may be symptoms of either using proprietary data formats that tie the user to particular products (and limit the types of processing that can be done) or using APIs rather than data formats, which leads to monolithic systems. Standard Generalized Markup Language (SGML), a highly successful ISO standard (ISO/IEC 8879:1986), allows a work flow of documents to be modularized: SGML can be used to define the interface format of the documents through the work flow. Apart from the extra certainty and rigor this can give to contracts for parts of a work-flow system, it also goes some way toward addressing some of the problems you mention.

Rick Jelliffe
Member, ISO Working Group on SGML
Sydney, Australia
ricko@allette.com.au

CodeWarrior No Be-All

In "The Be-All of Operating Systems" (May) you say, "Because of its Mac heritage, CodeWarrior has not traditionally generated thread-safe exceptions." This is Metrowerks' fault, not that of the Mac OS, which has had a threads library for many years. Apple cannot compel vendors to take advantage of Mac OS features; it's only fair that you castigate those vendors, not Apple, in print.

Maynard Handley
handleym@apple.com

We didn't intend to castigate anyone, but we should have made it clear that Metrowerks' past lack of thread support was a shortcoming of its compiler, not of the Mac OS.—Rex Baldazo, technical editor

It's Worse than You Thought

I find the estimate of $400 billion to be spent on the year-2000 problem ("Year 2000 Promises Strange Days Ahead," February) to be preposterous. If you estimate an average worldwide salary of $30,000—generous outside the U.S.—per programmer, with the four years that remain in which to solve the problem, you get an estimate of over 3.3 million programmers working nonstop until midnight on December 31, 1999. Somebody had better call the folks at Microsoft and tell them to free up their programming talent.

Jim Hyde
jhyde@rwbeck.com

The $400 billion figure that we quoted is actually the low end of the Gartner Group's (Stamford, CT) assessment. Gartner estimates that there are 220 billion lines of extant COBOL code. Locating code that must be modified, modifying it, and testing the modifications will cost 30 to 40 cents per line of code. Beyond the programming phases, additional costs of a year-2000 initiative, such as awareness, design, acceptance testing, implementation, documentation, and project management, increase the estimate to $1.10 per line of mainframe code.

Gartner also factored in the costs associated with languages other than COBOL, as well as the cost of fixing nonmainframe client/server systems, a good deal of which is associated with the labor-intensive process of assessing the problem. The result is a global, macroeconomic-based estimate of $400 billion to $600 billion that covers the years 1995 through 1999.
—Dave Andrews, news editor

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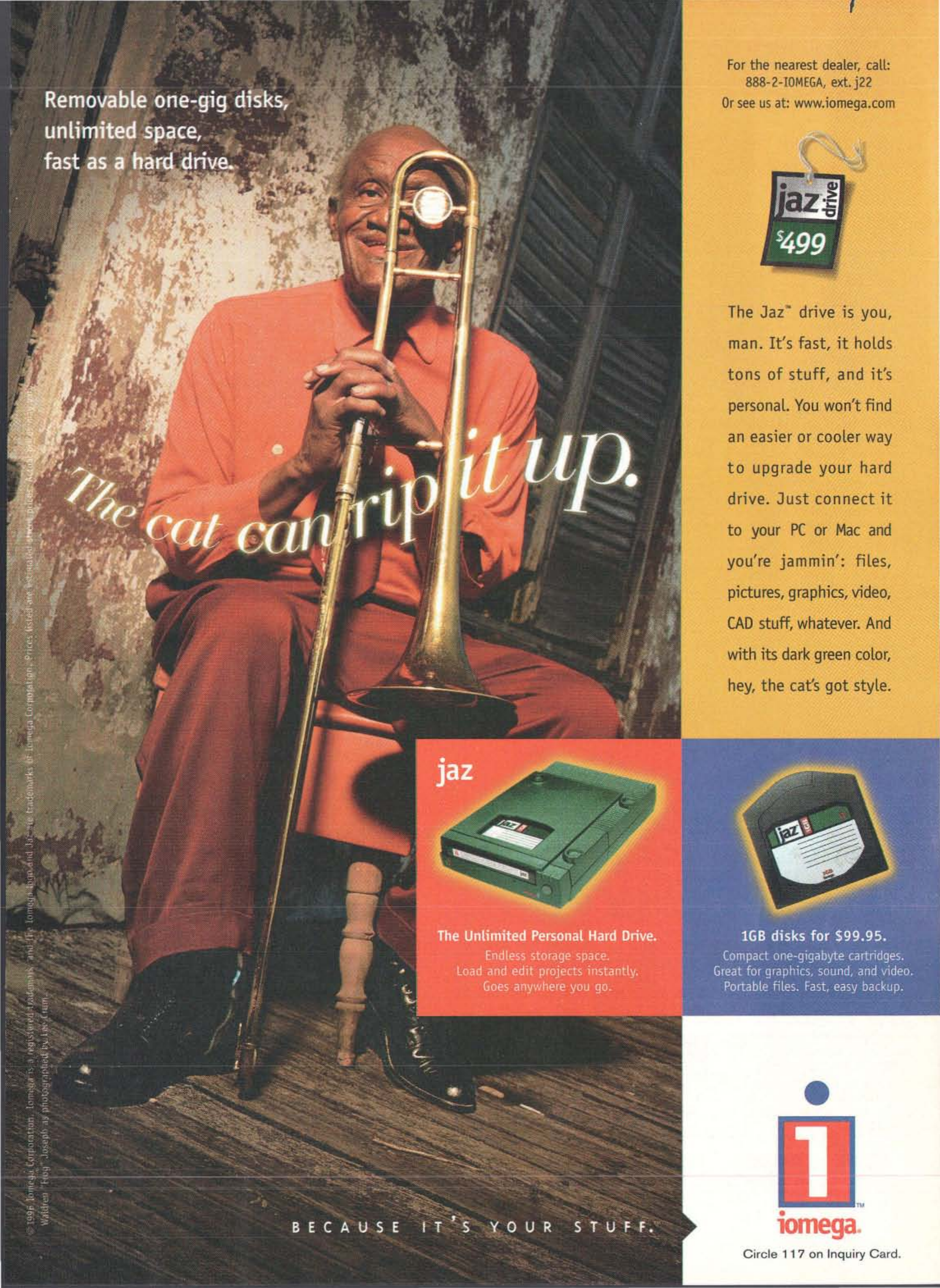
Due to a typographical error on page 176 of the April issue, we omitted a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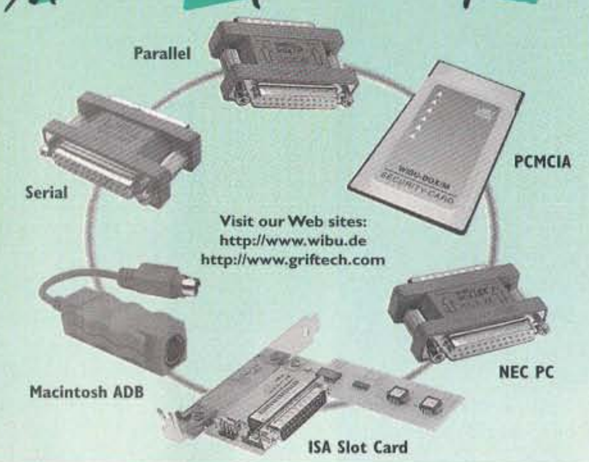

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inbox

hyphen in the uniform resource locator for V Communications. The company's correct URL is http://www.v-com.com.

In our June comparison of ISDN terminal adapters ("Building Bandwidth"), we attributed the three units' poor transfer performance with V.120 communications set at 115.2 Kbps to some serial-port limitations on one of our Dell test systems. Since then, we've learned that both our test systems support 115.2-Kbps communications. We must therefore attribute all the blame to the terminal adapters.

The numbers in the third pie chart in the text box "Market Forces" on page 52 of the May issue add up to 101 due to a rounding artifact. We should have noted that in the caption.

COMING UP IN SEPTEMBER

COVER STORY:
CAN CABLE SAVE THE INTERNET?

Just as more businesses are building mission-critical applications that rely on the Internet, the network of networks is straining under bandwidth bottlenecks. Are cable modems really up to the task? Is ADSL a better solution? What are the implementation issues?

SPECIAL REPORT:
TELECOM

The telcos and the computer industry dream of a single all-digital network that will carry every type of data over one wire using a small set of protocols—and replace today's physically and logically distinct networks. BYTE examines the technology, protocol, bandwidth, and API issues that must be resolved before video, voice, and data networks can merge.

STATE OF THE ART:
SOFTWARE QUALITY IN A CLIENT/SERVER ENVIRONMENT

Here's what you need to know to create and debug complex applications in a distributed environment, from developing accurate specifications, to maintaining code quality in a teams environment, to real-world testing on a variety of platforms.

CORE:
OPTIMIZING JAVA

Java interpreters pay a speed penalty for their flexibility. Here's how developers can significantly speed up Java code with some help from optimizing compilers and judicious design.

REVIEW:
HEWLETT-PACKARD'S LASERJET 5M

The crown prince of the desktop laser market features PCL6, a radical departure from previous versions of HP's page-description language.

NSTL LAB REPORT

In our hardware Lab Report, NSTL looks at multifunction telephony boards that provide data, fax, and voice communications.

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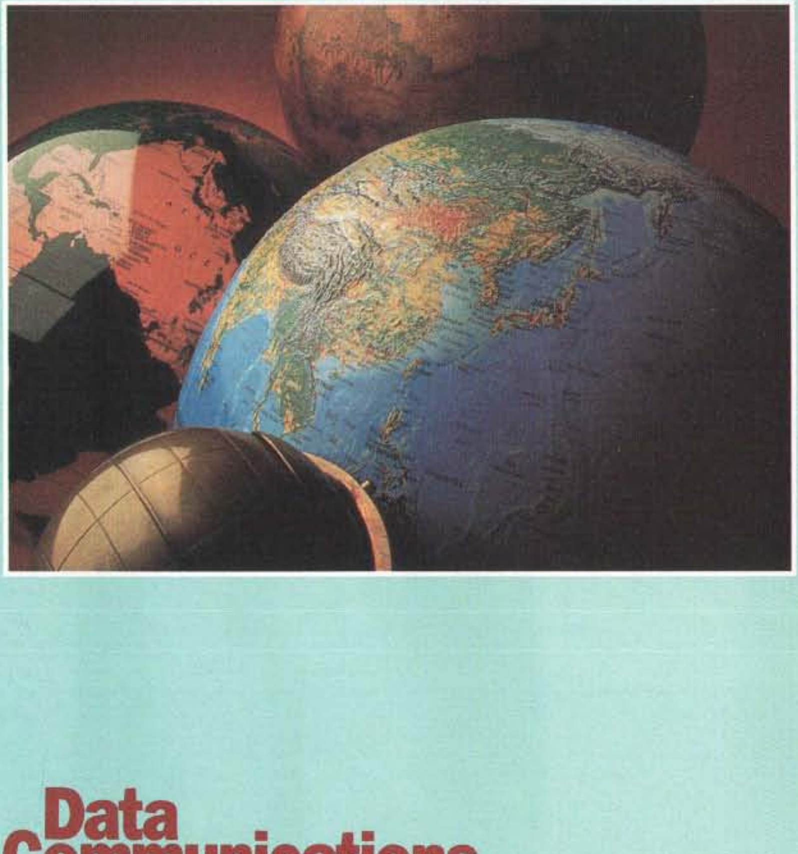

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NETWORK WITH ASIA It's no secret that the Asia-Pacific market is about to reach critical mass. Multinational companies, large end-user organizations, PTTs, VARs, and distributors throughout the region are in a hurry to find new technology. They've already seen what enterprise networks and applications have done for their counterparts in the U.S. and Europe. And many don't have a legacy infrastructure to protect. ▼ Now there's a simple, cost-effective way to get your product message to the industry's top networking talent in the more than 20 national markets that make up this hotbed of opportunity—*Data Communications Asia-Pacific*. **WE'LL TAKE YOU THERE** Since 1972, *Data Communications* magazine has been making a name for itself in the Asia-Pacific region, establishing its reputation as required reading among technical networking professionals from Australia to New Zealand and Bangladesh to Thailand. ▼ Now we've expanded our coverage of this critical marketplace with *Data Communications Asia-Pacific*. Each month, this regularly scheduled editorial package emphasizes regional products and services and investigates national regulatory environments. **TUNE INTO THE CHANNEL** Doing business in Asia means reaching vendors and customers through distribution channels. And *Data Communications Asia-Pacific* can put you right in the pipeline. A full 25 percent of our Asia-Pacific readers work at VARs, distributors, systems integrators, and outsourcers. **TRAVEL FIRST CLASS** *Data Communications Asia-Pacific* delivers all the award-winning editorial included in our regular issues. It's written and published in English, the language that Asian networkers use to discuss technology and talk to their suppliers. And it's headed up by To Chee Eng, our full-time Asia-Pacific editor working out of our new Singapore bureau. ▼ If you're targeting Asia-Pacific, go with the magazine that corporate networkers across Asia and the Pacific Rim count on for the global perspective on today's networking technology. For information about advertising rates in *Data Communications Asia-Pacific*, just contact your local sales representative.

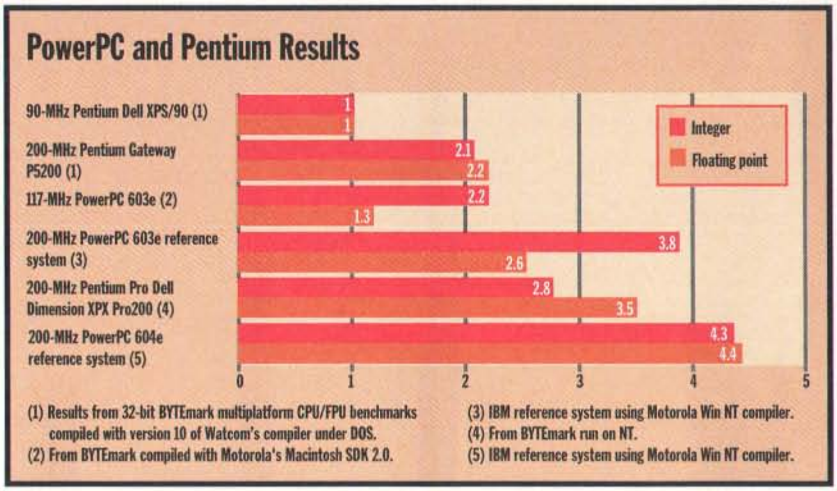
bits News & Views

New Desktop Standard: 200 MHz

Power users rejoice! Advances in processor technology bring new levels of affordable performance.

A new round of desktop and notebook systems with affordable but powerful 200-MHz processors will arrive throughout the second half of the year for PC-compatible systems and the Mac. Starting in June, the first systems using Intel's 200-MHz Pentium arrived, beating the 200-MHz 603e and 604e from Motorola/IBM out of the gate. However, companies such as Apple, Power Computing, and Umax Computer, who are basing their new Mac OS–based systems on the latest PowerPCs, should find the extra wait worthwhile. That's because early results from running BYTE's 32-bit multiplatform CPU/FPU BYTEmark tests (see the chart) indicate that the 200-MHz 603e and 604e outperform the 200-MHz Pentium and Pentium Pro, respectively.

PowerPC and Pentium Results



(1) Results from 32-bit BYTEmark multiplatform CPU/FPU benchmarks compiled with version 10 of Watcom's compiler under DOS.
(2) From BYTEmark compiled with Motorola's Macintosh SDK 2.0.
(3) IBM reference system using Motorola Win NT compiler.
(4) From BYTEmark run on NT.
(5) IBM reference system using Motorola Win NT compiler.

Mainstream 200-MHz BYTEmark CPU/FPU results.

Both IBM and Motorola say they will release specific pricing for the 603e, a low-power-consumption processor that targets notebooks and entry-level desktops, and the 604e, which targets desktop and entry-level server systems, later this year. However, Power Computing says it will ship the first of its systems using the new PowerPC processors this summer, and that prices will be competitive with or better than equivalent Wintel PCs. Apple and other manufacturers say new PowerPC-based systems will ship this year.

Besides the price/performance battle between the PowerPC and x86, Intel is finding strong competition in its own backyard in the under-$600 200-MHz category. While Intel pursues numerous strategies in making the Pentium Pro a more affordable desktop PC (see "Pentium Pro Moves to the Desktop," June BYTE), its $599 200-MHz Pentium will soon receive pressure from Cyrix's 6x86-P200+. Cyrix says that when the 6x86-P200+ (which actually runs at 150 MHz with a new 75-MHz system bus) ships in volume this month, it will deliver application performance that slightly exceeds that of Intel's Pentium. And Cyrix is selling the 6x86-P200+ for $499. Whether you use a Mac or a PC, your next top-of-the-line system will probably have a "200" in it.

–Dave Andrews and Tom Thompson

geek mystique

Watch your notebook; it's become a popular target for thieves. According to Safeware Insurance (Columbus, OH), which specializes in computers, approximately 208,000 notebooks sold in the U.S. were reported stolen last year. That's about a 40 percent increase over 1994. One trick that we've heard about: A thief will get between a victim and his or her notebook at an airport security check-in and then stall at the metal-detector gate. Meanwhile, the criminal's partner steals the notebook as it comes off the conveyor belt.

First came product placement shots, in which vendors paid big bucks to Hollywood producers in exchange for prominent visibility in a movie. Then came movie tie-ins, where a feature film release coincided with the release of new CD-ROM titles or high-tech toys. Now it has come to this: Barbie does CAD. This fall, Mattel Media will release an interactive CD-ROM program that lets budding clothes designers create their own ensembles for Barbie, the venerable 12-inch-high fashion doll. The title will include enough fabric that you can feed through a laser or ink-jet printer to create 10 outfits. Cut out the pattern and, voilà, you have a new outfit. The Barbie Fashion Designer ($35) will have built-in bad-fashion prevention. If your design suffers from bad color coordination, the program rejects it.

Vendors Eye Internet Telephony Standard

The best things in life are free, and, for now, so is making phone calls over the Internet. More than a dozen companies, with almost as many proprietary technologies, are producing Internet telephony programs for personal computers. However, analysts believe this free ride may not last.

An immediate threat comes from the America's Carriers Telecommunications Association (ACTA), a trade association of long-distance carriers. ACTA has petitioned the FCC (http://www.fcc.gov) to remove from the market products like VocalTec's (http://www.vocaltec.com/) Internet Phone, Quarterdeck's (http://www.qdeck.com) WebTalk, NetSpeak's WebPhone (http://www.netspeak.com), and Third Planet Publishing's (http://www.planeteers.com/) DigiPhone.

The ACTA petition, which has met with strong resistance from the Voice on the Net (VON) Coalition (http://www.von.org/) of telephony software businesses, is widely expected to be denied by the FCC. After all, the FCC is in the carrier regulation business, not software regulation. Says Nate Zelnick, senior analyst for Mecklermedia (Westport, CT), which is a trade show producer and publisher of Internet-focused titles, "The Telecomm Reform Act of 1995 deregulated the telecommunications industry. It didn't put it in a straitjacket."

That said, Zelnick doesn't expect Internet telephony to play a major role in most people's lives. "The big problem with Net telephony is that a $10 device called a phone already lets you make long-distance calls. You can use a computer, voice card, and software; but then your 'free' phone service must be paid for up front, instead of on a usage basis." But he also says that for businesses that make many long-distance calls, especially to branch offices, "Internet telephony makes a great deal of sense."

Harley Ungar, an analyst and consultant for the New York City–based research and consulting firm Jupiter Communications, believes that interoperability among different vendors' products will be a key requirement for wide acceptance of Internet telephony. "Ultimately, there must be an interoperability standard, but I don't see this happening until the Internet becomes a mass market." Ungar predicts that this won't occur until the "turn of the century, when a third of the population will be using the Net."

Lee McKnight, principal research associate for MIT's Internet Telephony Interoperability Project (http://rpcp.mit.edu/~itel/), is working to ensure that Internet telephony interoperability standards arrive long before the year 2001. He is helping to pull together the proposed Internet Telephony Interoperability Consortium (ITIC). This industry and education group will promote open standards that will be issued via either the Internet Engineering Task Force (IETF) or the WWW Consortium for the benefit of companies and users alike. With telephony and computer powerhouses like AT&T, Microsoft, MCI, and Netscape, plus Internet telephony companies, attending the first organizing meeting of the ITIC, open standards seem possible. Without standards, McKnight says, "None of this will go anywhere."

McKnight is not interested in just the technology. For him, the real questions are: How will the technology be deployed, managed, regulated, and paid for? The last is critical. For now, there's no charge, beyond the initial investment and monthly Internet access fees, for voice over the Internet. However, McKnight says this will change.

"No one has a good idea right now what the financial model will be," McKnight says. "But economic analyses of voice services over the Internet, including cost evaluation, pricing, and yield management models, will produce a viable model."

McKnight also says that while ACTA's petition will fail, "There's a risk or chance that in the future, the FCC may attempt to regulate the Internet. I don't expect it to happen soon, but the risk is there and grows as commercial traffic such as real-time voice services grows." Still, he believes that the future of Internet telephony is bright. According to McKnight, we will see "a whole new range of Net/telephony services. There will be new applications that we can't dream of today. By the twenty-first century, we'll be looking at the first or second generation of standardized products and services that combine the Internet and telephony."

–Steven J. Vaughan-Nichols

yeah, but...

Inconsistent availability of ISDN prevents this useful technology from ever becoming as popular in the U.S. as it is in Europe.

Yeah, but the ISDN situation continues to improve to the point that companies such as JetStream ((408) 777-4300) have released ISDN hubs and communications suites specifically for telecommuters who want the features and power of a company's PBX extended to the home office. Teloquent ((800) 468-6434) also uses ISDN for its Distributed Call Center and Video Call Center. Although Teloquent officials say limited ISDN deployment in the U.S. has resulted in a smaller potential customer base, that situation is improving.

ISDN is just an interim step on the way to asynchronous transfer mode (ATM), ADSL, or cable modems.

Yeah, but those services are still immature in many ways. ATM will likely succeed in the long term. But ISDN will also satisfy an immediate need for midrange data access and a wide variety of services, including videoconferencing, branch-office interconnection, and Internet access, especially as telephone companies improve their ISDN service and support.

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Stratus PC Server Wins Best of Comdex

Stratus Computer and its fault-tolerant Pentium Pro–based Radio PC Cluster server that supports N-way clustering under Windows NT won BYTE's Best of Show and Best System awards at Comdex Spring '96. Finalists for Best System were Ross Technology's SPARCplug, an add-in workstation for tower PCs; Digital Equipment's Prioris ZX 6200MP four-way Pentium Pro PC server; and Hewlett-Packard's quad Pentium Pro–based HP NetServer LX Pro.

Best Technology winner was FlashPix, a technology developed by Eastman Kodak, Hewlett-Packard, Live Picture, and Microsoft. This new imaging architecture should make imaging applications easier, faster, and more consistent.

Best Portable winner was IBM's ThinkPad 560, a 4.1-pound, 1.2-inch-thick notebook with a 12.1-inch active-matrix screen. Best Portable finalists were Texas Instruments' high-end 133-MHz Pentium-based TravelMate 5375ST and Rockwell International's wearable, Pentium-based Trekker 2020.

Quadrant International's VideoWave, a PCI-based video-compression and editing card that uses wavelet compression, won Best Multimedia Hardware. Finalists were Matrox Graphics' MGA Mystique, a 2-D/3-D PC graphics accelerator, and the Color QuickCam, a $229 color digital video camera, from Connectix.

Best Multimedia Software winner, Scala MultiMedia MM100 for Windows ($249), lets you create titles with graphics, animation, symbols, text, and music. Finalists were EMD Enterprises' GLView, an $89 3-D viewer and Virtual Reality Modeling Language (VRML) browser, and Jamba, a $495 visual authoring tool for creating Java applets, from Aimtech.

The award for Best Connectivity Hardware went to NetworkEye/270 Frame Server, a $299 stand-alone network device that provides one image per second from a Connectix digital camera, from Microplex Systems. Finalists were the $225 DWIntjack, from Konexx, and Champion Computer Technologies' FE10/100, a $289 10-/100-Mbps Fast Ethernet Type II PC Card.

Adobe Systems' $49 ATM Deluxe 4.0 Type I and TrueType font management program won as Best Utility. Finalists were DeskMan/2 for OS/2, from DevTech, and Starfish Internet Utilities.

Mannesmann Tally's T7070 Color Ink Jet was the only clear winner in the Best Printer category. Best Peripheral winner was the ViewSonic P815, a 21-inch monitor. Peripheral finalists were the Desktop Projector 4100, from Proxima, and Eastman Kodak's DC-20 digital camera.

The Best Internet Product winner, EchoSearch from Iconovex, is a search tool that analyzes and indexes results from multiple Internet search engines. Level\5's Quest Server tool, which lets you publish relational databases to a Web site, and MCI's networkMCI Backup service, which lets you securely back up data to remote servers, were finalists.

Best Connectivity Software winner was Show N Tel, an applications development kit for creating telephony applications, from Brooktrout Technology. The finalist was MobileWare Personal Edition for Win 95, a peer-to-peer remote-connectivity program.

Sybase's Powersoft group won Best Development Software for PowerBuilder 5, which adds support for applications partitioning, compiled code, and Internet access. The other finalists were VisualAgeGenerator 2.2, from IBM's Software Group, and Symantec's Café for the Mac.

Best of Comdex Contact Information

Best System: Stratus Computer ((508) 460-2000). Digital Equipment ((508) 493-5111); Hewlett-Packard ((408) 553-4300); Ross Technology ((800) 774-7677).

Best Portable: IBM ((800) 772-2227). Texas Instruments ((800) 848-3927); Rockwell International ((800) 321-2223).

Best Multimedia Hardware: Quadrant International ((800) 700-0362). Matrox Graphics ((514) 685-2630); Connectix ((800) 950-5880).

Best Multimedia Software: Scala ((703) 713-0900). EMD Enterprises ((800) 898-9363); Aimtech ((603) 883-0220).

Best Connectivity Hardware: Microplex Systems ((800) 665-7798). Konexx ((619) 622-1400); Champion Computer Technologies ((216) 646-2500).

Best Utility: Adobe ((800) 682-3623). DevTech ((803) 790-9230); Starfish Software ((408) 461-5899).

Best Printer: Mannesmann Tally ((800) 843-1347).

Best Peripheral: ViewSonic ((909) 444-8800). Proxima ((619) 457-5500); Eastman Kodak ((716) 724-4000).

Best Internet Product: Iconovex ((800) 943-0292). Level\5 ((800) 444-4303); MCI ((770) 668-6406).

Best Connectivity Software: Brooktrout Technology ((617) 449-4100). MobileWare ((214) 952-1269).

Best Development Software: Powersoft ((508) 287-1500). IBM's Software Group (Somers, NY); Symantec ((800) 441-7234).

future watch

New RAM technologies are almost as plentiful as ticks on a hound in August, but one that's gaining momentum is the new synchronous DRAM (SDRAM) standard. Extended data out (EDO) RAM starts running out of performance at bus speeds above 66 MHz. Because it runs at only 70 nanoseconds, EDO RAM incurs wait states at higher speeds. However, SDRAM can handle bus speeds of up to 100 MHz. SDRAM is also better for multimedia. Due to its multibanked nature (two now, four in future generations), one bank can send data out while the other gets recharged (this increases performance by decreasing latency).

System vendors are already using SDRAM, and officials at DRAM vendor Hitachi America (Brisbane, CA) predict that by the end of 1997, half of all systems will have SDRAM. Sherry Garber, who is vice president of Semico Research (Phoenix, AZ), a semiconductor research company, is only slightly less optimistic. She predicts that 40 percent of systems then sold worldwide will have SDRAM.

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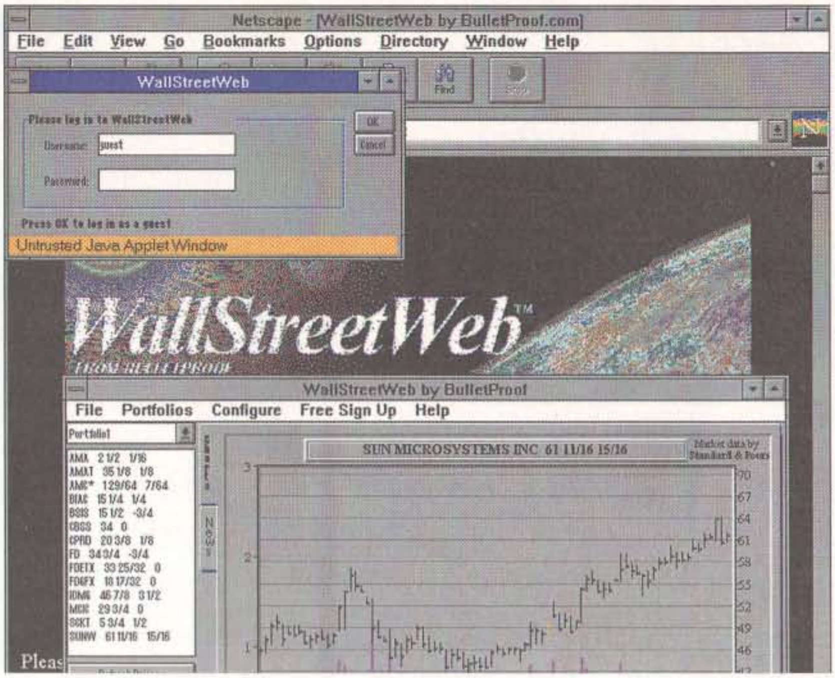
Java Business Applications Arrive



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News
Market data by Standard & Poors
3
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49
46
Pleas

Please log in to WallStreetWeb

Username: guest

Password:

Press OK to log in as a guest

Untrusted Java Applet Window

Portfolio1

AMA 2 1/2 1/16
AMAT 35 1/8 1/8
AMC* 129/64 7/64
BIAC 15 1/4 1/4
BSIS 15 1/2 -3/4
CBSS 34 0
CPRD 20 3/8 1/8
FD 34 3/4 -3/4
FDEIX 33 25/32 0
FDGFX 18 17/32 0
IDMG 46 7/8 3 1/2
MCIC 29 3/4 0
SCKT 5 3/4 1/2
SUNW 61 11/16 15/16

SUN MICROSYSTEMS INC 61 11/16 15/16

BulletProof's WallStreetWeb real-time portfolio management tool.

When many people think of Java, they think of window dressing for Web pages. However, new client/server Web-based programs written in Java have a strong business focus.

BulletProof's WallStreetWeb (http://www.bulletproof.com/wallstreetweb/), a portfolio management tool, lets subscribers monitor and track their stock holdings in real time from any Java-enabled browser on the Net (see the screen). WallStreetWeb's integrated paging system can inform users of important portfolio changes. On-line help and stock searches are also available.

Java is well suited for distributed database administration and simple query access by outside users. One such Java intranet application is User Administrator from BulletProof (http://www.bulletproof.com/admindemo/useradmin/). Users and administrators access the same Java client but have different levels of access query and update privileges.

Another Java application, Connect's Issues (http://www.connectcorp.com/), provides cross-platform, on-line issue management services. Issues, which is searchable and navigable, is part of an enterprise system that contains help desk and enterprise sales components. Each component has its own user interface and built-in functionality.

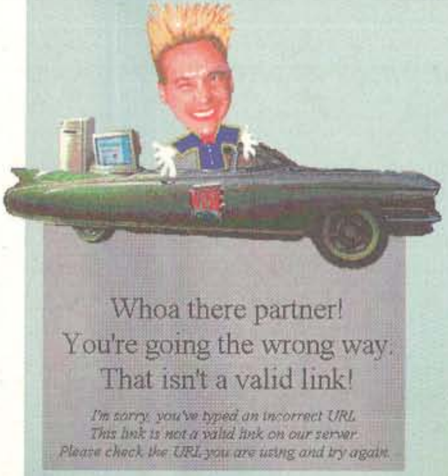
Java is also finding early use in the customer service sector. Prominence Dot Com's (http://prominence.com/) Web-based customer service system called Virtual Service Rep (VSR) integrates with databases to augment and partially automate Customer Service Representative (CSR) functions. When accessed, VSR authenticates the customer and attempts to provide automated assistance. You can configure VSR so that a human CSR need never be involved in routine ordering and service issues. If the customer's request requires human interaction, the request is priority-queued for CSR help. During the wait, VSR presents the customer with targeted products and services. Human CSRs can access a customer's help-session history and account information, and VSR suggests a product or service for the CSR to offer the customer.

Many software developers are rushing to provide Java extensions to their applications. Dun & Bradstreet Software's Java client for its SmartStream system is an example. Expect to see more companies port their enterprise software to the corporate intranet.

Whether the network and other advantages will help the "dynamic" Webtop application supplant the "static" desktop application is still undetermined. However, these things are certain: Java is being extended, the language is rapidly maturing, and the potential applications for Java are practically endless.

–Michael Shoffner

Bug of the Month



Whoa there partner!
You're going the wrong way.
That isn't a valid link!

I'm sorry, you've typed an incorrect URL.
This link is not a valid link on our server.
Please check the URL you are using and try again.

Look Out for the Guardrails on the Information Highway

There's no lack of characters on the Internet, including programmers who have creative ways of informing users about errors. Although the screen at the left is not necessarily a bug, it sure is an entertaining example of the types of error messages one encounters on the Internet. You know you've taken a wrong turn when you hit this page (http://199.72.95.3/realestate/index.html) on the Web.

–Edmund X. DeJesus

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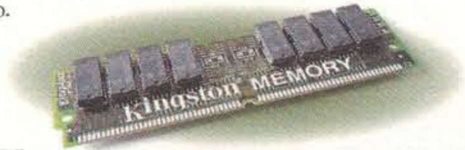

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Forget $500 PCs: How About Free Ones?

Those $500 network PCs may be a bit overpriced. While industry leaders from such companies as Oracle, Sun Microsystems, and Microsoft debate the merits of networking-centric computers (aka Web PCs) that sell for $500 or less, others are creating products and services that assume widespread availability of ubiquitous "free" PCs. Of course, these PCs won't really be free. A new service-based approach to computing, similar to that of cellular telephones, provides a computer for free as part of a service contract. Instead of paying for the cost of the PC up front, you receive your computer when you sign up for a service (e.g., Internet access or cable PC). Proponents say such a solution is cost-effective and easy to evolve.

The technology to make this happen already exists. WorldGate Communications (Trevose, PA) has demonstrated a device it calls TV On-Line (TVOL), which displays Web pages that are specially formatted for TV viewing by a cable company's server at the head end. With TVOL, you can launch to uniform resource locators (URLs) displayed on a TV commercial, send and receive Internet e-mail, participate in newsgroups, and join chat rooms. Subscribers don't pay for the devices. They just subscribe to the TVOL service for about $5 a month, and they get the hardware automatically, plus 5 free hours of access.

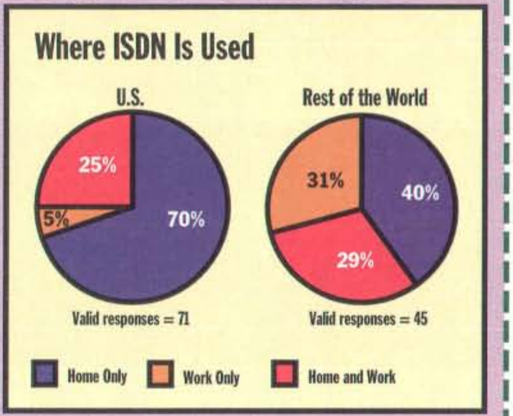
continued

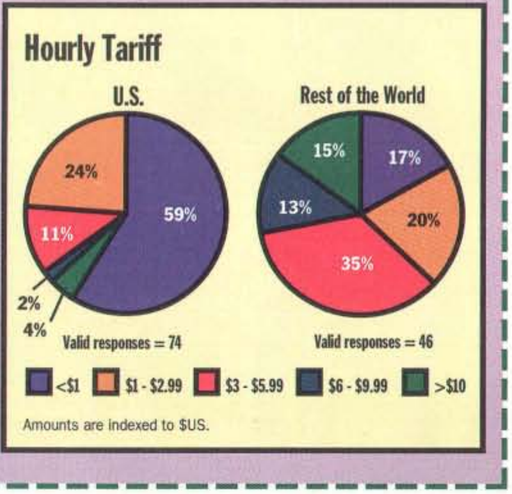
Survey

ISDN at Home in the U.S.

According to the results of a survey taken on BYTE's Web site (http://www.byte.com), U.S. residents are almost twice as likely to use ISDN exclusively at home than in the rest of the world, where use is distributed more evenly across home, work, or both. The reason: When you can get it in the U.S., one-time installation fees and monthly access charges are lower than in the rest of the world, which in this survey consisted primarily of residents in Germany, the Netherlands, Switzerland, Great Britain, and Spain. For example, 48 percent of respondents in the U.S. can get ISDN installation for less than $100, while only 31 percent of the rest of the world can do so. Hourly ISDN rates are also generally lower in the U.S. (see the figure).

So why aren't more U.S. businesses using ISDN? Comments from survey respondents suggest that installation woes or fear thereof may be the cause. In some regions, getting ISDN installed still involves many phone calls and configuration hassles. U.S. businesses weighing the higher bandwidth and potentially higher support costs of ISDN versus lower bandwidth and support costs of plain old telephone service may opt for the latter solution.





Amounts are indexed to $US.

Codetalk

by Rick Grehan

Look, It's VB—No, Wait—C++

It had to happen: a visual development environment undergirded by C++ yet so similar to Visual Basic that you have to stop and look closely to distinguish the two. Powersoft's Optima++ brings VB-style form-based programming to C++.

Is it a Delphi killer? That's part of it. Sybase's SQL Anywhere product is well integrated in Optima++. Add to that bound controls and the bundled ODBC support provided by Intersolv's DataDirect ODBC drivers, and Optima++ becomes a formidable client/server database foundry.

Is it a VB killer? That's part of it, too. When you launch Optima++, you'd swear you've launched VB. Up pops a blank form window, bespeckled with a placement grid. You can drag visual controls from a tear-off toolbar to populate a form. Optima++'s Object Inspector is the spitting image of a VB object's properties window.

Is it RAD? That's another part. You can, at almost anytime in the development process, select Run from the menu and see how your work is progressing. All the compiling and linking are as unobtrusively automated as I've ever seen.

Say you've just deposited a command button on your form window, and you want to specify its behavior. When you right-click on it and select Events from the pop-up list, a mini-menu opens, showing the events that the object responds to. Select an event, and an editor window opens.

Here's the interesting part: Whenever you're in the editor window, you can move the cursor over to the form window, select an object, and drag it back into the editor. This opens a reference card that provides quick access to all the methods that object understands. Furthermore, the reference card can actually "write" code for you.

I did all my explorations with the Developer edition of Optima++. Introductory pricing is $199, which will probably last through September. The Professional and Enterprise editions that will add team development, Internet tools, Java, and more should appear later this year. I'm keeping the sectors warm on my hard disk for their arrival.

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Even free notebooks may be possible in the future. Imagine a device, smaller than a laptop, that when unfolded is 8 by 11 inches, half of it a color display, half a keyboard, and that through the miracle of radio frequency cells connects you to the Internet from anywhere. Although such a notebook isn't available today, the wireless aspect is, at least in certain parts of the country. Metricom (Los Gatos, CA) has installed a wireless network that allows connection to the Internet from anywhere in the San Francisco Bay area over a 28.8-Kbps modem. Metricom is also operating in Seattle and Washington, D.C. Don Wood, executive vice president of Metricom, says that it is solving the low-cost wireless access problem (connect rates start at $29.95 a month, $40 with a modem). Says Wood, "If there were a less expensive portable device available, the market for these wireless services would be a much larger segment of the population."

Malcolm Bird, chief executive of Acorn's Network Computing Division (Cambridge, U.K.), questions how many features consumers are willing to sacrifice in exchange for a low-cost mobile device given today's LCD screens and other notebook components. He says such a mobile unit may be viable in the future. "But I think the real solution may be that network computers become so ubiquitous that wherever you turn, there is a network access device." Whether it's a notebook or a PC, your free network computer will not hold personal data; instead, it points you to storage where your personal information is kept secure.

Companies such as SureFind (http://www.surefind.com), XactLabs (http://www.xactlabs.com), and Connected (http://www.connected.com) have provided the technology for private secure data storage on the Internet. Unlike with your hard drive today, you won't worry about losing your data or running out of space with these storage services, because your data is stored in at least two secure mirrored sites that provide unlimited space and tools to help manage your data. When you need printed output, copy shops like Kinkos will offer low-cost local printing services. From any public PC phone, a friend's PC, or a free PC that you just picked up at the store, you will compute without worrying about losing your data or running out of storage space.

–Gary W. Tripp

Book Reviews

Unpredictable Discoveries

Because new technology seems to combine with a blasé attitude to produce forgetfulness, it's probably not a bad idea to look back from time to time, if only to be reminded of how things got started after all. A good place to start along these lines is with the birth, if you will, of the Internet. Katie Hafner and Matthew Lyon describe it in *Where Wizards Stay Up Late: The Origins of the Internet.* This is an account of the engineering and programming required to set up ARPANET, which, of course, is the Homo erectus of modern networking.

WHERE WIZARDS STAY UP LATE
The Story Behind the Creation of the INTERNET
KATIE HAFNER and MATTHEW LYON

The truth is often a surprise. What, after all, could be less cool, more fuddy-duddy, and even vaguely hemorrhoidal than Dwight D. Eisenhower and his pal Neil McElroy, the Sultan of Soap, who ran Procter & Gamble? Well, the next time you send a piece of e-mail, you might take a moment to realize that some of what they did was not so bad after all.

Eisenhower and McElroy, who served as Secretary of Defense, had a belief in science and technology. McElroy, in particular, thought that pure research, if left to its own devices, would be able to justify its existence. But it's not enough to believe. You also have to put beliefs into action, and to this end, Eisenhower and McElroy managed to set up ARPA. The critical thing was the atmosphere that was established in the agency right from the beginning. ARPA saw itself, as the authors point out, as a "group that would take on really advanced 'far-out' research."

So, after setting up a place that had the right attitude, Eisenhower, and then John F. Kennedy, produced the rocket fuel that technological research requires. They turned on the money faucet. The effect of this setup was obvious. For instance, in 1966, Bob Taylor wanted to do something about hooking different computers together. Taylor, a Texan, had made the jump from psychoacoustics to computing and was director of the Pentagon's Information Processing Techniques Office. He went to see the director of ARPA, Charles Herzfeld. In 20 minutes, Taylor walked away with the money, a million dollars to start studying the problem.

In fact, once the right people were involved and the money was there, the Internet seems inevitable. It may be true that all failed research projects are the same, but each successful one is successful in its own way, and this one's success involved a lot of people. The number and variety are staggering–theorists, engineers, administrators, programmers, engineers, graduate students, and the employees of Bolt Beranek and Newman, the Cambridge consulting firm that oversaw the installation of ARPANET's first computers.

J. C. R. Licklider stands out. He was one of those gifted and endlessly curious men who had the knack of attacking what seemed to be widely different problems. If nothing else, he was a visionary when it came to the possibilities of computing. In the Pleistocene Epoch (aka 1960), Licklider, who wrote a paper called the "Man-Computer Symbiosis," foresaw a "massive network" in which "home computer consoles" (not then invented) would be linked.

The truth is, though, there were many others: Vint Cerf, a California computer scientist who came up with such notions as a routing computer to connect networks. Or Larry Roberts, who deserves a lot of the credit for ARPANET, and who, from the beginning, had an instinct for networking computers.

The writing of *Where Wizards Stay Up Late* could be better than it is. At best, it is comfortably readable; at worst, it has the aspect of too much research ground through a word processor. Its biggest flaw is that the authors never allow you any sense of the personalities of the people involved. Sometimes characters are given an identifying tick (one is coldhearted, another is friendly), but even the authors seem to forget such identification after a while.

Nevertheless, the book makes good reading for anyone interested in where the Internet came from, and how policy decisions, particularly where research is concerned, affect the outcome.

–Craig Nova *is the author of eight novels and the recipient of many awards and prizes, including an award in literature from the American Academy and Institute of Arts and Letters. You can reach him on the Internet at nova@sover.net.*

WHERE WIZARDS STAY UP LATE
The Origins of the Internet
by Katie Hafner and Matthew Lyon; Simon & Schuster; ISBN 0-684-81201-0; $24

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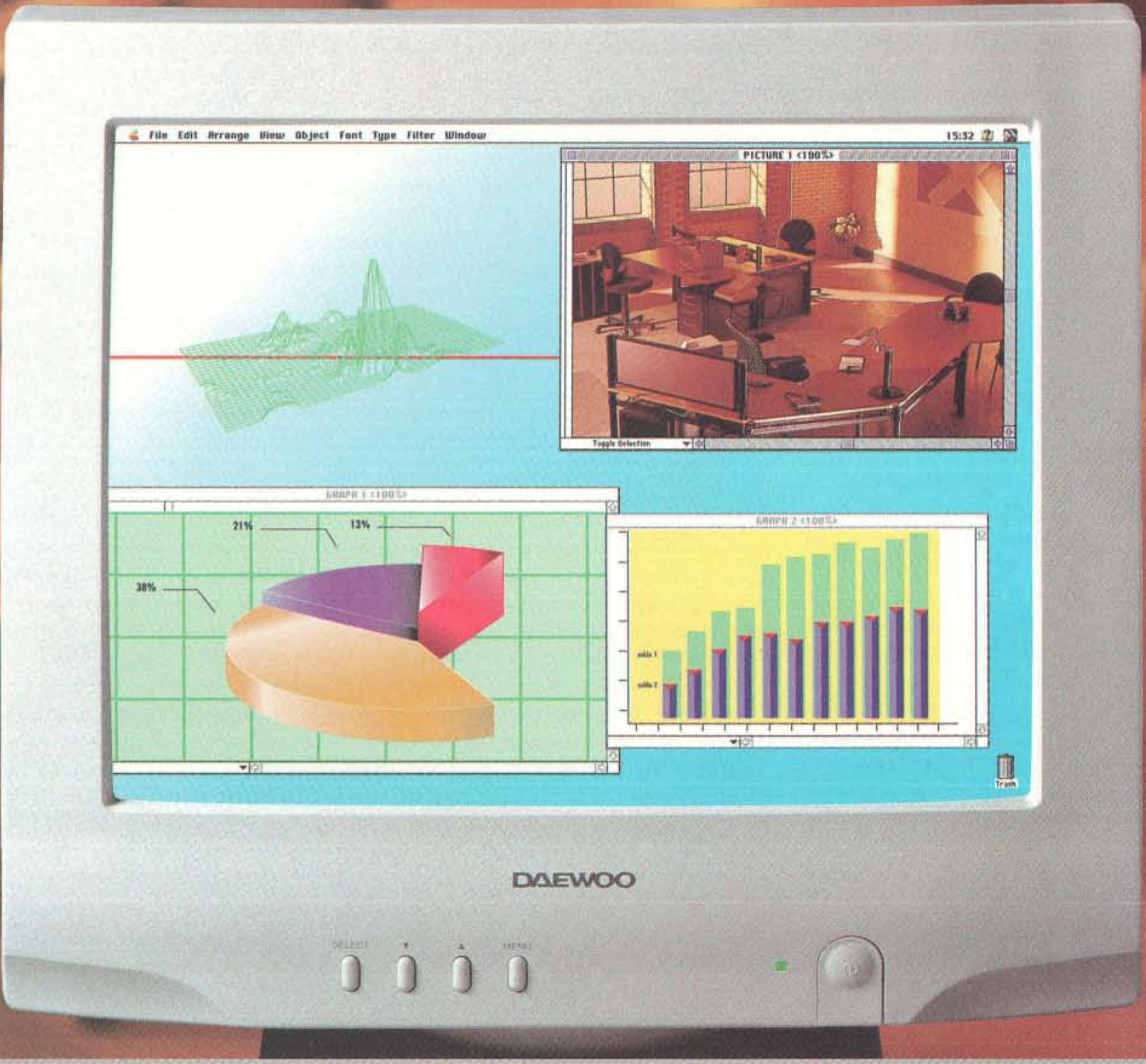

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Windows 95 Stymies Blind Users

Despite promises to make Windows 95 more accessible to developers who create adaptive technology for the blind, much-awaited technology remains in Microsoft's labs and is still months away. Blind computer users who want to use Win 95 applications or the Internet require a screen reader, which is assistive software that translates standard video monitor output into the spoken word or braille alphabet. Unfortunately, not all software and OSes work well with screen readers and other forms of adaptive technology. Because developers of screen-reader applications can't always determine what's displayed on the screen of a Win 95 application, these programs don't work as well as they could, which costs the disability community jobs and opportunities.

When advocates in the disability community, including the National Council on Disability (Washington, D.C.), complained to Microsoft about the lack of embedded system hooks in Win 3.x, Microsoft said it would make Win 95 more compatible with screen readers and adaptive equipment in general. But features to assist the blind have fallen behind schedule. They include an off-screen model that will keep a record of all information written to the screen, letting a blind user accurately read what is on the screen using special software. According to Microsoft, the off-screen model is still under development and not even ready for alpha release.

Trying to make the best of the situation, adaptive software developers are rolling out new screen readers for Win 95. Without the off-screen model, however, the job is difficult. Nevertheless, Automatic Screen Access for Windows (MicroTalk, (903) 832-3471), the latest entry in this category, supports both Win 95 and Win 3.x. Biolink's ((604) 984-4099) ProTalk 32 screen reader supports Win 95 and NT.

But adaptive technology specialists say computers would be more accessible if software developers worked with the disability community to create products everyone can use. **–Joseph J. Lazzaro**

Datapro Report

How to Create a Network Security Policy

As businesses increasingly rely on computers and networks, the potential for damage from electronic theft or sabotage also increases. A network security policy can make your business less vulnerable to data loss caused by theft, computer viruses, or hard drive failure. Besides establishing policies for personnel in an organization, a network security policy helps a company avoid claims of arbitrary enforcement when disciplinary action becomes necessary.

A network security policy should work with the overall information systems and telecommunications security policy and your disaster recovery plan. A good way to start on the network policy is with a quick look by a small working group. This doesn't require much staff time and resources, and it can save you from implementing preconceived notions as to where security is good or bad. An excellent way to determine where security needs improvement is through surveys of information management and the end users in a business. By surveying both groups, you get diametrically opposed perspectives on the network. Because people who live with the system, day in and day out, get to know it well, a survey of the user community is useful.

However, assembling a questionnaire is an art. To encourage honesty, don't ask for names unless respondents wish to supply them voluntarily. To encourage widespread participation, make it easy for employees to complete the survey. One way to do this is to automate the survey: Put it on a log-in screen and save the results into a file. It will make the survey visible, and the cost for the entire survey will be minimal.

Ask people which systems they use, but do not be so specific that you can identify the individual. Ask users if they have noticed ways to gain system entry through unexpected paths, privileges in excess of those really needed, unusual events that might imply tampering, virus-like symptoms, laxness in controlling physical access, vulnerable systems, and servers or applications that are insecure yet whose absence could damage the organization. It is also important not to convey a sense of the kind of answer you would like. "Is system security satisfactory?" is a poor question because the user reads it in the context of the requester and a yes or no answer is possible. Instead, ask questions that provide even-numbered, not odd, graduated responses. These force the user to take a position.

Checkoff items on the survey are fine, but the survey should ask for measured, thoughtful responses. Indicate that you will use the survey results in a security evaluation, and that users' responses are appreciated and will be used. If it is possible to conduct personal interviews, do so. You must also poll network and computer professionals.

Once you have reduced the collected survey data into tabular form, the working group should arrive at one of three conclusions: Nothing but minor changes are needed. Changes are required, but don't call for an organization-wide effort. A full-scale review plus substantial changes are required. In the last case, you need to make a formal presentation to management. If a task force is approved, it should represent every element of the organization in developing appropriate controlled access to hardware, data, and applications.

The task force or working group should review such areas as physical security, access control, whether media such as wireless communications are properly encrypted, personnel policies, audits, external media such as shareware programs and floppy disks, backups, employee awareness, training, and administrative policies. The hardest part of a network security policy is its execution, and it is much easier to add new encryption to a WAN than it is to change people's behavior. Old habits die hard, and replacing them takes time. Often, a year will pass before the new policies take hold. However, with persistence, managers can reduce or eliminate the threats to important business data.

–Fred Simonds is the author of *Network Security: Data and Voice Communications* (McGraw-Hill, (800) 262-4729 or http://www.books.McGraw-Hill.com; e-mail, customer service@McGraw-Hill.com). For more information on Datapro Information Services reports, call (800) 328-2776 or (609) 764-0100.

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cd-rom review

One-Stop Convergence Infomart

It's hard to get a handle on the convergence industry—it's a fast-moving, growing, and changing beast.

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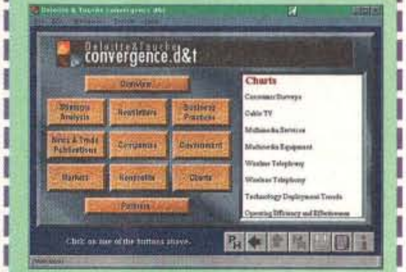

An uncluttered interface makes it easy to find what you want.

The CD-ROM is easy to navigate and search, but the $2495 question is, why pay that much money for a compilation of mostly already-published material? A better question to ask is how much time the CD-ROM will save you by providing all the information in one place. According to Deloitte & Touche, "You would have to visit more than 200 [Internet] sites to obtain equivalent content." Obviously, the company is selling convenience and the fact that the CD-ROM yearly charges are fixed as opposed to paying for on-line time with a service such as Nexis. From my quick perusal, there's much good information on the first edition.

–Rich Friedman

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Lower Prices, Modularity, Lead Notebook Trends

What's next for PC notebooks? The answer is either not very much or a lot, depending on how far out you look. In the near term, notebooks will see mostly minor changes: larger hard drives (2 GB and more), faster processors (150 and 166 MHz), and more memory (8 to 16 MB standard). However, you will see a big reduction in the time it takes for features to show up on notebooks after appearing on desktops.

A key trend is the emergence of the true desktop-replacement notebook at far lower price points than before. Complete multimedia notebooks with CD-ROM, sound, and other high-end features are becoming the standard notebook system, with prices around $2500 and up depending on configuration. "It is getting harder and harder to come up with innovative, gee-whiz technology," says Bruce Stephen, who is a market analyst with International Data (Framingham, MA). "The market really revolves now around the continuous loading of the latest leading-edge technology into these products."

Typical of this trend is a new notebook from NEC. NEC's ((800) 388-8888)Versa 2400 line brings high-end features to the value-priced market. Available as either a 100- or 133-MHz Pentium, the system will include a minimum of 1 GB of hard disk storage, an 11.3-inch double supertwisted nematic (DSTN) display, and a snap-in 6× CD-ROM drive with a large software bundle. Prices for the Versa line will start at $2299 for a 100-MHz system without a CD-ROM drive ($400 more buys the CD-ROM drive).

While the Versa 2400 represents the state of the market now, Compaq's new Armada 4100 ((800) 888-5858), slated to ship this month, portends a new trend in modulatrity that will let you tailor your system to your needs. The 1.5-inch-thick Armada 4100, which starts at about 5 pounds and is available with an 11.8-inch active matrix display, converts to a standard notebook with an integrated floppy drive or extra battery pack, and, when you attach the mobile CD unit, to a full multimedia system. The Armada 4100 is the first of several modular systems you can expect to see in the near future. "You will definitely see modularity and interesting design options," says Al Kirts, a spokesman for Gateway 2000. "There will be a whole new generation of notebooks in 1997 in what will be a design-driven market." Look for other major vendors like IBM, Toshiba, and NEC to offer systems like this.

You can also expect that 12.1-inch screens will become the standard, while some vendors will release notebooks with 13.4- and 13.8-inch LCDs. These larger-screen formats won't be mainstream soon, however. New 12.1-inch panels are just coming into full production, and 13-inch panels are too expensive and will require a new wider design.

–Jon Pepper

Notebooks: Weak Link in Ergonomics

Ergonomics is a hot topic among computer vendors and users, but the term *notebook ergonomics* remains an oxymoron. While mouse and keyboard makers continually search for new ways to make their devices more ergonomic, or comfortable to use, the same can't be said for notebook makers. Instead, they say privately, the basic idea is still to "get as much as possible in the smallest package possible."

Consequently, few if any notebooks have ever shown any real ergonomics. One exception is the SENS 810 Multimedia Notebook from Samsung ((800) 933-4110). It features an adjustable split keyboard that you can pull out at angles from the center to allow more natural wrist and elbow positioning. The keys also are full-size. The only other ergonomic approach was probably the much-touted but ill-fated IBM Butterfly, which had a keyboard that expanded to full size from its subnotebook format. Beyond that, don't expect much from notebooks in this area.

True, LCD screens don't have the ergonomic drawbacks of monitors in terms of emissions, but otherwise, the smaller keyboards and pointing devices that are generally inferior to conventional PC mice and keyboards will leave users who are concerned about ergonomics in a dilemma.

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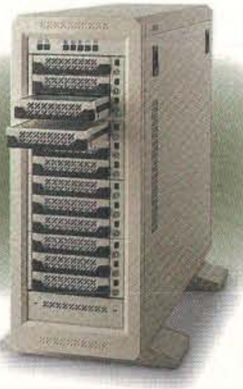

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Blasts from the Past

15 Years ago in BYTE

BYTE devoted almost the entire issue to Smalltalk, Smalltalk-80, and other object-oriented-programming topics. In one article, Apple's Larry Tesler said, "You can write almost any program better in a language you know well than in one you know poorly. But if languages are compared from a viewpoint broader than that of a narrow expert, each language stands out above the others when used for the purpose for which it was designed." Hold that thought.

10 Years ago in BYTE

We covered object-oriented programming again, only this time we talked about several languages, including object-oriented Pascal, Forth, and C++. Ironically, many programmers' object-oriented language of choice is C++ today, because its object-oriented extensions are built on a language that many already know well. In fact, designers of Java have told BYTE editors that they made the new language similar to C++ because of the latter's extensive use in the programming community.

5 Years ago in BYTE

Smalltalk appears again, but not this time as a cover story. In an article that simultaneously looked back and ahead, authors Adele Goldberg and L. Peter Deutsch wrote that they hope that in 2001 objects will be boring (i.e., no longer radical ideas). However, as Microsoft and Netscape duke it out over who will set the next Internet programming standards, objects will be anything *but* boring.

MOLAP, ROLAP, Overlap

Jeff Stamen, senior vice president of Oracle's OLAP division, discusses the convergence of multidimensional and relational OLAP databases.

BYTE: Where does Oracle stand on the debate between multidimensional OLAP versus relational OLAP?

Stamen: I think the term OLAP [on-line analytical processing] has been overly exploited. People have lost sight of what it really is: data analysis that includes data navigation, query, modeling, what-if, forecasting, and data mining. The way some people have been using the term, if anything has any kind of multidimensional reporting or drill down, they call it OLAP. I don't view these as OLAP products. I view these as products that have extensions to their reporting capabilities. That said, in the OLAP world, there has been a debate as to whether you can do real OLAP as I describe it, directly on relational data, or whether you're required to have a multidimensional database.

A lot of people have said, "Well who cares about that? We care more about the results, and whether it's a multidimensional database or going directly against a relational database is secondary." That's basically true. That should be secondary, but it's not irrelevant. There are a lot of issues in loading, managing, and dealing with data. All things being even close to equal, why not keep the data in the relational database, which everybody knows how to deal with, manage, operate, maintain, and enhance. Our view is you can do much of what you need to do directly against relational databases, generally called ROLAP.

BYTE: When would you want your data in one versus the other?

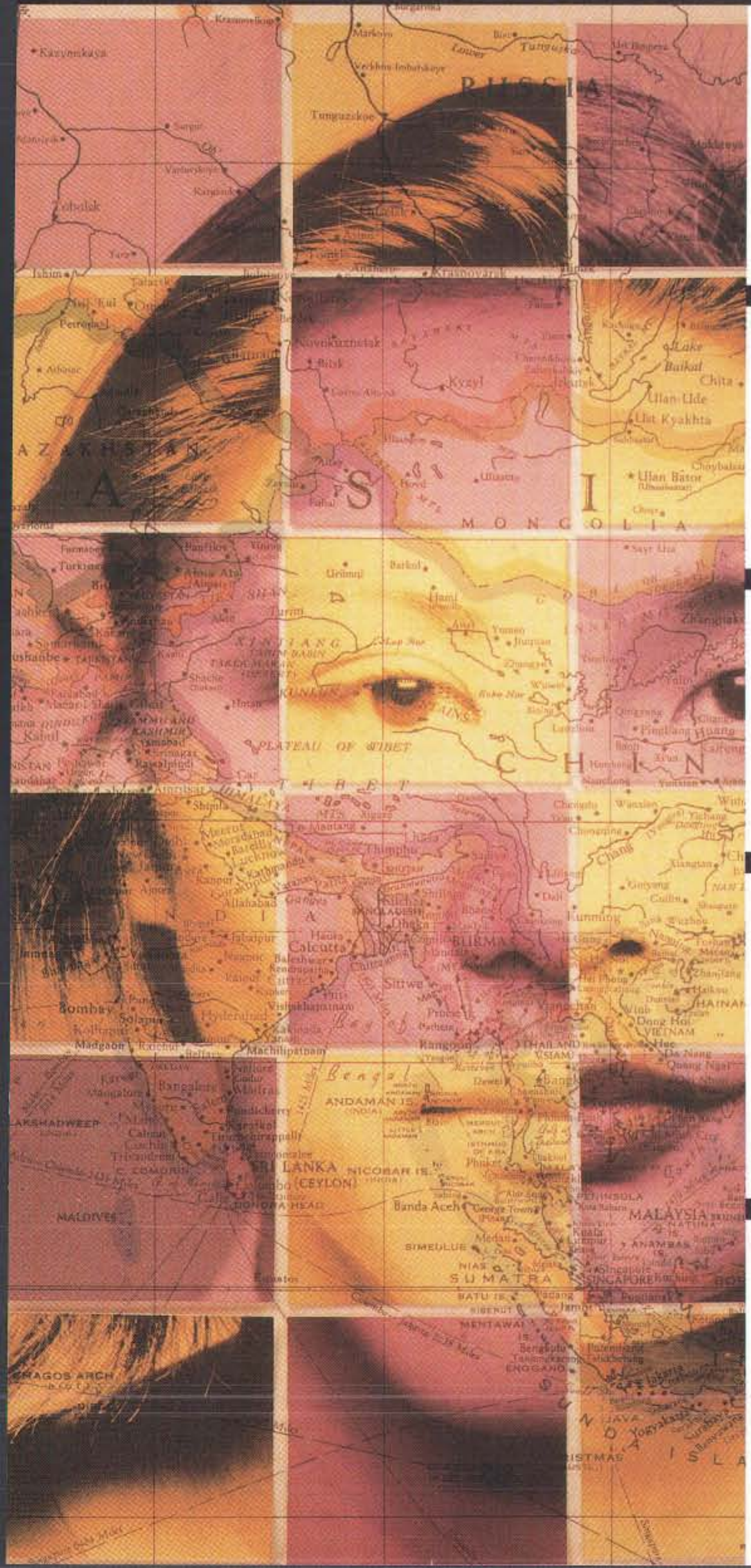
Stamen: If you're dealing with lots of data, tens or hundreds of gigabytes, it's not realistic to have to take that data and keep updating multidimensional databases with it. That's an expensive and time-consuming proposition. What you'd like to do is go up against that data directly. On the other hand, if I'm [creating] complex multidimensional models or what-if scenarios (what-if meaning simulations, projections, forecasts, and so on), then I'm dealing with very complicated calculations that cannot be expressed in SQL. In that case, it's not realistic to do most of my work against a relational database. You need to do it in a multidimensional cache. It's the old 80/20 rule: For 80 percent of the data, you never have to leave the database. For the 20 percent of data created from higher-level aggregations, stage it in a multidimensional cache.

BYTE: What benefits can users expect from a relational database engine that integrates multidimensional analysis?

Stamen: Long term, and we're talking about a two-year time frame, we're going to be offering one engine that integrates multidimensional data with relational data in the same engine. So you could think of it very much like a data blade for multidimensional data in the Oracle engine itself. With this future program, instead of having just SQL APIs, you'll have both a SQL and a multidimensional API. And the multidimensional API will be the same Express [Oracle's current multidimensional database program] API that we have today. Everything you run today will still run, except that when it actually accesses data, it will get it via the Oracle engine. Performance will be terrific, because we're actually going to have a multidimensional access method right in the Oracle database. But the main benefit is much less support overhead. The benefits are you have one data manager, one set of database administration utilities, and one data dictionary.

BYTE EXTRA

International



The Digital Desk

Paper and electronic documents integrate in new ways. Page 40IS 3

DRAM Prices Plummet

But Taiwanese manufacturers increase production. Page 40IS 4

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The German version of Windows 95 supports CAPI 2.0. Page 40IS 7

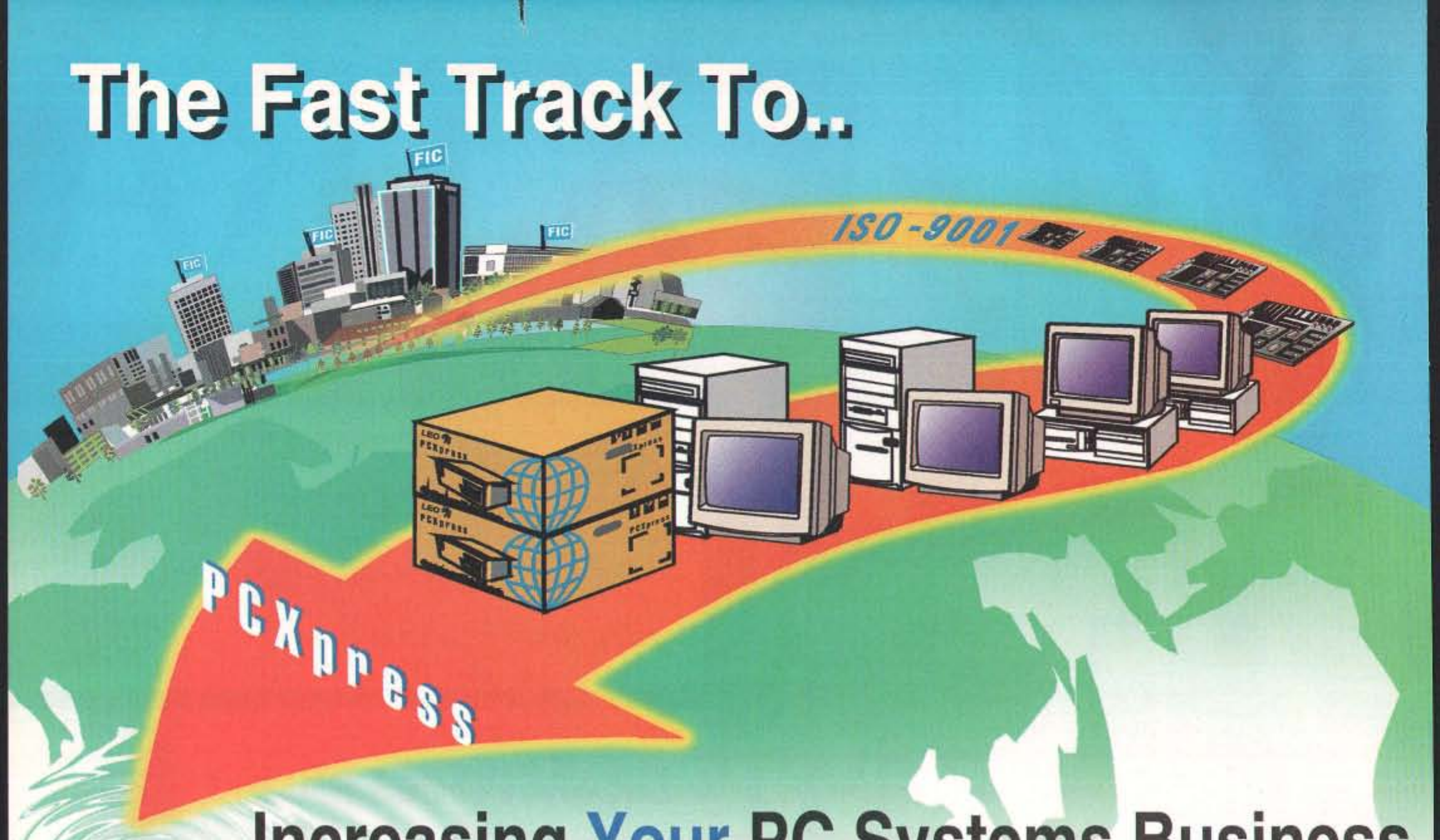
Best CASE Scenario: Choosing OO Methods

The payoff is matching tools to a flexible methodology. Page 40IS 11

Asian Internet Fever

Pent-up demand strains the region's infrastructure. Page 40IS 16

The Fast Track To..



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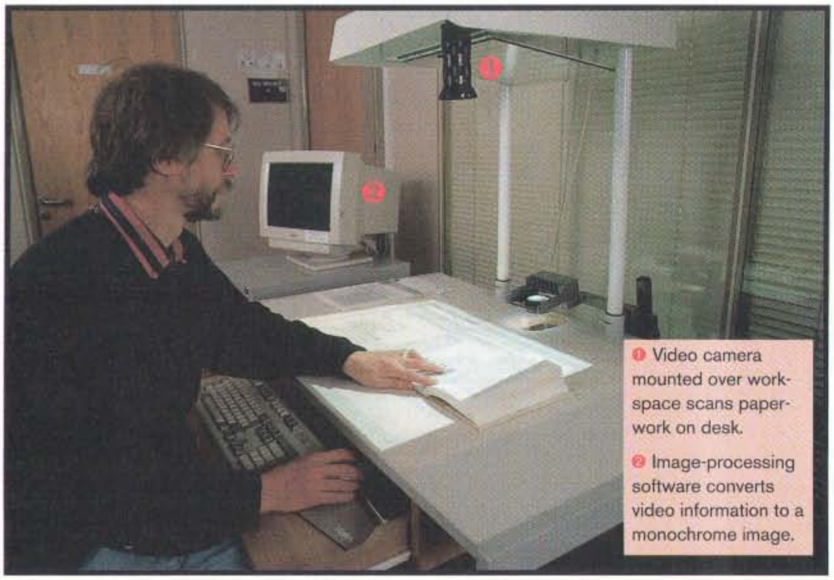
Paper-to-Computer Link

Rank Xerox Research wants to make document technology independent of language, physical location, and medium.

Rank Xerox Research Centers in Grenoble, Switzerland, and Cambridge, U.K., are working on unique ways to integrate information. Some of the researchers' recent projects include work-flow and knowledge management systems for the World Wide Web, multilingual document search and retrieval systems, and a so-called digital desk that seamlessly integrates paper and electronic documents.



❶ Video camera mounted over workspace scans paperwork on desk.

❷ Image-processing software converts video information to a monochrome image.

The digital desk brings both paper and electronic documents under the control of a single computer system.

The Digital Desk

Problem: How best to integrate paper and electronic documents.

Solution: The digital desk tries to bridge the gap between your desk—cluttered with paper memos, newspapers, and magazines—and your PC. A video camera mounted over the workspace scans paper pages within a specific zone without you having to move them from the desk.

Technical challenge: To maintain the relationship between the real document and the scanned image.

Benefit: It's easy to combine electronic and paper documents in work-flow and document management applications.

The Virtual Library

Problem: How to archive, search, and retrieve multilingual documents at high speeds.

Solution: The Callimaque/XDOD virtual library system indexes and cross-references a document's content as well as its structure. It's based on a client/server environment. The library system, implemented at France's Institut d'Informatique et Mathematique Applique, allows researchers around the world to electronically access papers published since the early 1950s. The system offers on-the-fly translation of a document's French-language abstract into English.

Technical challenge: High-speed electronic document distribution and context-sensitive translation.

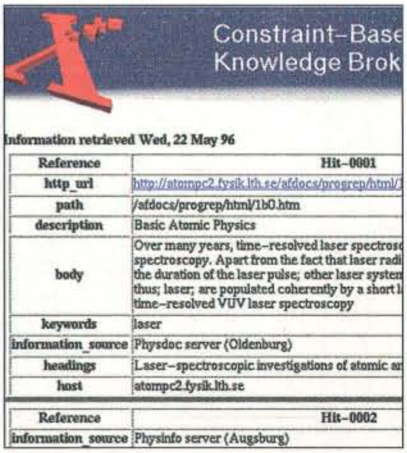
Benefit: Opening up foreign-language archives to English speakers.

Knowledge Broker Services

Problem: To efficiently manage and retrieve electronic information on the Web or in any other digital library.

Solution: Constraint-based knowledge broker services watch for information that meets preestablished natural-language criteria (e.g., "find all books written by Umberto Eco that are not novels"). They create compound documents on-the-fly and are able to reuse retrieved information.

Technical challenge: To explain the complex semantics of natural language to broker agents.



Constraint-Base
Knowledge Brok

Information retrieved Wed, 22 May 96

Reference	Hit-0001
http_url	http://atompc2.fysik.lth.se/afdocs/progrep/html/
path	/afdocs/progrep/html/1b0.htm
description	Basic Atomic Physics
body	Over many years, time-resolved laser spectros spectroscopy. Apart from the fact that laser radi the duration of the laser pulse; other laser systen thus; laser; are populated coherently by a short l time-resolved VUV laser spectroscopy
keywords	laser
information_source	Physdoc server (Oldenburg)
headings	Laser-spectroscopic investigations of atomic ar
host	atompc2.fysik.lth.se

Reference	Hit-0002
information_source	Physinfo server (Augsburg)

Knowledge Brokers will bring natural language searches to the Web.

Benefit: Distributed data sources such as the Web and on-line libraries become much easier to use.

–Rainer Mauth

DRAM Price War Coming

As Taiwan's manufacturing capacity grows, memory will get cheaper.

Asian companies have dominated the DRAM market for more than a decade. Japan took the market lead in the mid to late 1980s, but South Korean companies have gained the upper hand over the last three years. Now, Taiwan is emerging as a new DRAM power in Asia.

There are between 15 and 20 wafer fabrication facilities on the drawing board or being built in Taiwan, many of which are DRAM factories or foundries (fabrication plants that manufacture chips for other IC companies). Because the cost of building a fabrication facility is more than $1 billion today, Taiwan is betting that the IC business—especially memory chips—will remain robust.

Several Taiwan suppliers will intensify the price wars in the DRAM market when they ship their first 16-Mbit parts during the second half of this year. Nan Ya Technology, Powerchip, United Microelectronics Corp. (UMC), and Vanguard are all readying their initial 16-Mbit parts.

Taiwan vendors will go toe-to-toe against established DRAM suppliers based on one factor: price. "Taiwan's DRAM manufacturers will play the role of a price killer in the market," says John Kuo, analyst with China Securities Investment Trust Corp. (Taipei). "When Taiwan DRAM makers ramp up production by the fourth quarter of this year or early next year, there will be another price war in the market."

Taiwan's entry into the DRAM market follows a steep drop in product prices over the last six months. A 1 x 16-Mbit DRAM on the spot market sold for about $54 late last year, but prices tumbled to $42 by the beginning of this year. A slowdown in the PC market caused 16-Mbit prices to drop to around $23 by the end of the first quarter of 1996. By the second quarter, the average price fell to about $13. Prices could stabilize or drop even further in Q4.

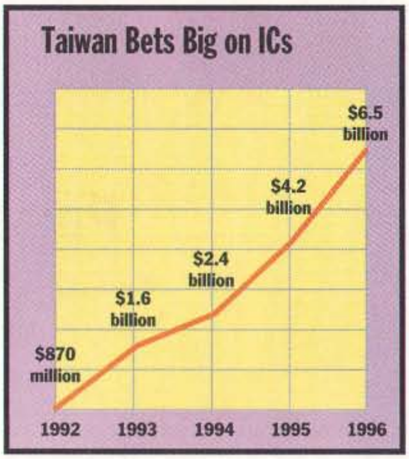
That's not stopping Taiwan, however. Vanguard and UMC have been shipping in quantities their respective 1 x 16-Mbit extended data out (EDO) DRAMs. Nan Ya Technology and Powerchip began sampling their 16-Mbit parts last June and July, respectively. Nan Ya Technology will sell 4 x 4-Mbit EDO DRAMs, while Powerchip will begin shipping 2 x 8-Mbit EDO DRAMs. Other Taiwan hopefuls will show 16-Mbit DRAMs later this year or early next year, including Mosel-Vitelic and Winbond Electronics.

The 1 x 16-Mbit DRAM, targeted for PCs, is currently the most popular configuration, while the 4 x 4-Mbit version is designed for high-end workstations and servers, says Pei-Lin Pai, director of marketing for Vanguard. The 2 x 8-Mbit DRAMs are also targeted for PCs, but the volumes are much lower than the 1 x 16-Mbit varieties, he adds.

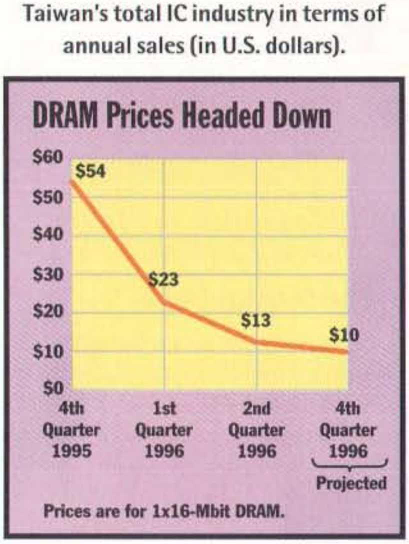
Taiwan IC companies have been successful in PC chip sets, SRAMs, VGA controllers, and flash memories. But Taiwan has failed in some cutting-edge businesses: UMC, for example, attempted to sell a 486 processor but exited that highly competitive market last year.

Taiwan has a lot to prove in the DRAM business. Local companies are much smaller than the memory giants in Japan and South Korea. For example, South Korea's Samsung, the world's largest DRAM maker with about 14.8 percent market share in 1995, had total chip sales of over $10 billion last year—an amount larger than Taiwan's entire IC output. Most Taiwanese DRAM hopefuls will be able to survive just by selling into the local PC and motherboard industries. In fact, local OEMs must import more than 80 percent of their components, including DRAMs, from foreign suppliers.

– Mark LaPedus



Taiwan's total IC industry in terms of annual sales (in U.S. dollars).

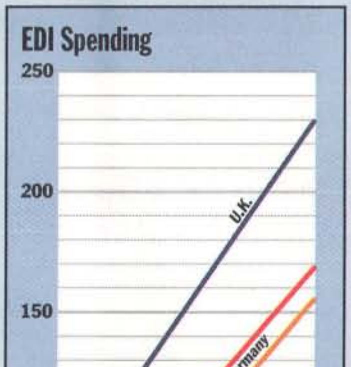


Prices are for 1x16-Mbit DRAM.

Taiwan's chip production will drive memory prices down.

European EDI Spending Increases

European spending on electronic data interchange (EDI) will grow at an annual rate of 20 percent to 1 billion ECU (European currency unit) in 2001, according to a study by Ovum, the London-based consultancy. In terms of money spent versus market potential, Sweden, the Netherlands, and the U.K. are the most mature markets for EDI.



Figures (in million ECU) include industrial EDI, electronic mail, the Internet, data network services, on-line card authorization, and reservation systems.

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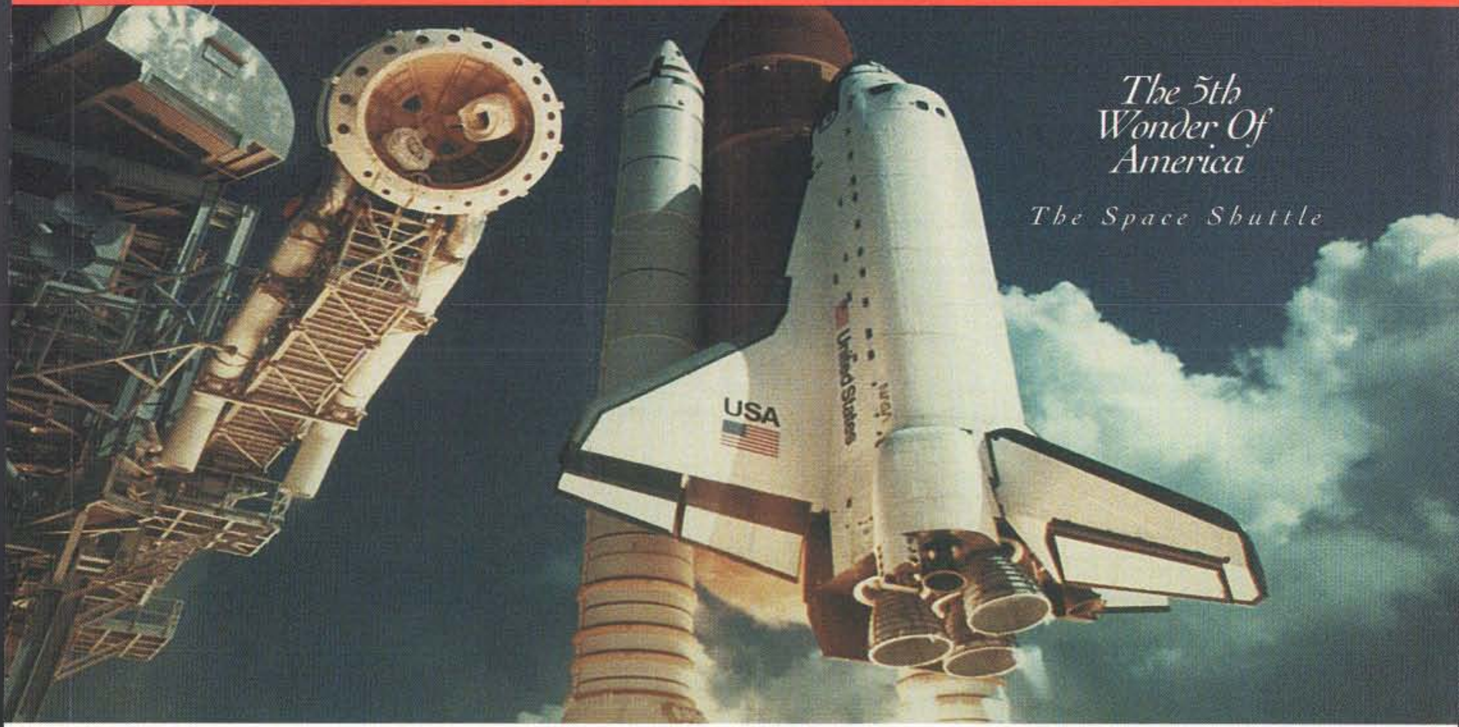

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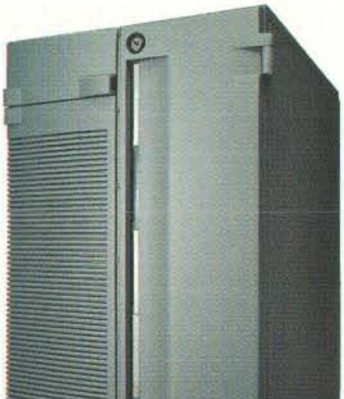

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PKWare Data Comp Lib for Win	£175
TCOMP/Multi-Platform 2.12	£105

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CodeBase 6.0	£270
CXBase Pro	£500
DBTools.h++ for ODBC	£1250
DISAM96 for DOS/Win	£715
Greenleaf Database Library 4.0	£180
List & Labels for Win (Pro)	£410
Objective Grid	£299
POET Personal SDK 3.0	£169
ProtoGen+ Client/Server NT	£1575
Raima DBM Engine+EADS 4.0	£740
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Real-Time Graphics Tools	£360

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ProBas 7.1	£210
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PC-Lint for C/C++ 7.0	£135

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XBasic Pro (Win32)	£199

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Oberon/F	£315
Oberon/F Dev Bundle	£569
Ofront (Oberon-to-C Translator)	£715
Oberon/F Arbitrary Precision Lib	£55
Oberon/F Source Code Analyser	£55
Oberon/F Statistical Profiler	£165
Logitech Modula-2 Dev Sys 4	£560
Stony Brook Prof Modula-2	£300

JAVA

Java now has enough tools to have its own section! Serious developers should check out the RAD tools such as Café & JFactory.

Borland C++ 5.0	£247
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Symantec Café Intro	£119
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News & Views

POWERBUILDER 5.0

Distributed Apps, Compiled Code, Internet and More!

Powersoft's new release has been some time coming but was well worth the wait! There are 3 variants, offering a variety of new features:

- **PowerBuilder Desktop** has all that you need to create standalone & workgroup client/server apps. There is a new 32-bit IDE, fully compiled code (based on the Watcom compiler), enhanced script editor, install disk builder, Data Pipeline translation utility, single-user Sybase SQL Anywhere, and ODBC drivers for most desktop databases
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- **PowerBuilder Enterprise** adds high-performance native drivers for Oracle, Informix, DB2, Sybase & MS SQL Server, support for distributed objects (or application partitioning), ObjectCycle, a C++ class builder, InfoMaker query & report tool, and the PowerBuilder Library for Lotus Notes

As this went to press, we were still waiting for UK prices, so you will have to call us to find out. Ask for the data sheet as well - we cannot do justice to all the new features here.

SOCKETTOOLS

The Complete Internet Toolkit

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- DNS Client queries IP addresses
- **POP3 & SMTP Clients** let you integrate e-mail into your apps
- **Telnet Client** logs in, with optional VT100/ANSI terminal emulation
- **RLIB** executes remote commands
- **ICMP/Ping Control** tests if a remote host is up on the network
- **WinSock Control** lets you write custom apps using TCP or UDP

There is also an async sockets control and a DLL with base64 & uu encode/decode. Only £195.

NET-INSTALL

Distribute Software over the Web

This is by far the easiest way to distribute your apps & data files on the Web or your Intranet. NET-Install eliminates the multi-step process of download-decompress-run setup.

Instead, an end-user simply clicks a link on your Web page and software is installed on their system - its that simple. All they need is the NET-Install plug-in for Netscape 2 (Win16 or 32), and all you need is the NET-Install Publisher's Toolkit at £235.

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The CAPI Puzzle

The German version of Windows 95 includes support for CAPI 2.0; other versions don't.

By Bob Emmerson and David Greetham

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Is ISDN the ideal platform for voice, fax, and video telephony that will replace analog phone systems? Or is it a medium for connecting computers and LANs? The answers likely depend on which side of the Atlantic you're on. Microsoft GmbH, the company's German subsidiary, added fuel to the debate when it included an ISDN/Common-ISDN API (CAPI) subsystem into the German version of Windows 95.

CAPI was developed by a group of German ISDN board vendors to access ISDN hardware in a straightforward manner. The latest version, 2.0, covers all ISDN services (data, voice, fax, and video telephony) and has interfaces for DOS, OS/2, Unix, and Windows 3.x, NT, and 95.

CAPI 2.0 was officially approved by the European Telecommunications Standards Institute (ETSI) last year; it now coexists with the French-led PCI ISDN API, which received ETSI approval earlier. Major telecommunications players, such as Siemens and Deutsche Telekom, have supported CAPI for several years, and such companies as Novell and Lotus have implemented the interface in their software products.

The German ISDN market, which has 50,000 B-channels coming on-stream every month, is seen as the most important in Europe. The German communications industry has several years of rock-solid experience with the early data-centric CAPI 1.1 standard. This is the reason why Microsoft GmbH decided to implement a CAPI-compliant ISDN subsystem, which it jointly developed with Acotec (Berlin, Germany), into the localized version of Win 95.

German Win 95 users can now install and run ISDN hardware in two ways. Some ISDN board vendors ship their products with 32-bit CAPI drivers; provided there are no incompatibility issues between the hardware and communications software, it's a fine solution. The other way deploys the CAPI subsystem that contains Microsoft's Network Driver Interface Specification (NDIS) driver and the board maker's corresponding ISDN driver (see the text box "ISDN and Windows 95" on page 40IS 8).

"The CAPI subsystem is one possible implementation of the CAPI 2.0 standard," says Hans-Jürgen Ortmann, ISDN software project manager at AVM (Berlin, Germany) and chairman of the CAPI Association. "But we recommend that users of our hardware deploy our 32-bit drivers and not the subsystem. Full and secure functionality can be guaranteed only if the drivers and controllers are produced by the same manufacturer," he explains.

Because it's based on a detailed technical specification—not a set of DLLs—CAPI is an open standard. Its specification includes low-level ISDN protocols (Layers 1 through 3), a set of message-handling prescriptions, and OS-specific kernels.

However, CAPI is open to manufacturer-specific features, and there's nothing to stop an ISDN board manufacturer from developing a bundled software and hardware solution to add more functionality. This means that the specification can be interpreted in different ways by different vendors and can cause incompatibilities between the communications software and ISDN hardware from different vendors.

The CAPI subsystem of Win 95 doesn't support any vendor-specific functions. This may be one reason why some German vendors initially didn't like the Win 95 CAPI subset. They also may have feared Acotec, an ISDN system vendor and co-developer of the subsystem, would gain a competitive advantage.

CAPI Subsystem Uses NDIS

The CAPI subsystem employs Microsoft's NDIS drivers and sets up the board as a LAN network card. Thus, the installation procedure of an ISDN board is the same as that for network boards. But users won't find any installation assistance for ISDN in the Win 95 on-line help. The subsystem lists the products of ven-

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dors who cooperated with Acotec and Microsoft in time for the release of Win 95. Boards that are not listed have to be installed with the manufacturer's driver disk.

Not all board vendors supply their own 32-bit CAPI 2.0 drivers, which means that users of non-German versions of Win 95 can't install these boards as a CAPI 2.0 device unless they buy the subsystem from Acotec. The only other choice these users have is to install 16-bit CAPI 1.1 drivers at the DOS level, which results in significantly lower functionality.

Networking Support

In March, Microsoft launched a suite of ISDN drivers for Win 95. But the ISDN Accelerator Pack, which is not CAPI compatible, increased the confusion. Europeans tend to view ISDN as a replacement of the plain old telephone service (POTS), while in the U.S. ISDN is treated as an Internet solution.

These different views persist when it comes to integrating ISDN with Win 95. The Microsoft U.S. view on ISDN is clearly network-centric. "ISDN is [only] one more network-transport [medium], like

ISDN and Windows 95

The German version of Windows 95 includes an ISDN/Common-ISDN API (CAPI) 2.0–compliant subsystem (called the *CAPI subsystem*) that invokes Microsoft's Network Driver Interface Specification (NDIS) drivers; the application then sets up the board as a LAN network card. Products from vendors who cooperated with Acotec and Microsoft in time for the release of Win 95 in Germany are listed but are not detected automatically. You install boards that are not listed by using the manufacturer's disk. You then select the relevant card and the Acotec CAPI 2.0 protocol in a procedure that's similar to installing a LAN card.

The use of NDIS has given rise to criticism in Germany. Why use network drivers if the user has no need to network? It's a good question, and Microsoft GmbH's answer is that it was a way of getting applications to talk to a wide range of boards.

The subsystem concept lets boards coexist in the same way as NDIS-managed network cards do. However, the practical benefit of coexistence is not obvious to the average user.

Communications Interfaces

Supports	TAPI	CAPI	ISDN Accelerator Pack
Voice mail	✓	✓	
Voice and speakerphones	✓		
Fax Group 3	✓	✓	
Fax Group 4		✓	
Eurofile transfer		✓	
64 Kbps		✓	✓
B-channel bundling (128 Kbps)		✓	
Remote access	✓	✓	✓

✓ = yes.

X.25, Ethernet, Token Ring, or ATM," says Charles Fitzgerald, ISDN program manager at Microsoft U.S.

The confusion surrounding ISDN in the German market comes from the fact that Microsoft's U.S. view prevails. Microsoft designed the ISDN Accelerator Pack for remote access via ISDN under Win 95. It's based on Microsoft's WAN-NDIS interface and therefore provides functionality for networking only; it does not support voice and multimedia capabilities, as CAPI does.

Currently Win 95 is missing the drivers that bind Microsoft's Telephony API (TAPI) and MAPI interfaces to ISDN. "Microsoft gives each application its own API, but what's needed is a general communications architecture for dial-up links," says Christian Lührs, marketing manager of Stollmann E + V (Hamburg, Germany), a founding member of the CAPI initiative. "CAPI has this flexibility, even if it lacks extended voice capabilities," he adds.

Some members of the CAPI initiative suggest that CAPI could be made an extension of NDIS for dial-up networks and that it could be accessed with different application interfaces. Microsoft GmbH agrees that the current situation can't be the final solution. Says Juergen Schwertl, Microsoft's ISDN coordinator: "We need to bind TAPI, MAPI, and NDIS to ISDN."

But he adds that making CAPI an extension to NDIS is not the way Microsoft will go. "This would add the burden of protocol implementation and maintenance to the NDIS driver. Software protocols should remain in the OS, because that's the only way to include changes or add functionality and stay compatible with existing hardware," he explains.

It's obvious that a lot of political positioning and posturing is going on. Microsoft and the German-led CAPI camp are coming from different directions, with different objectives and agenda. Currently neither party has all the answers, but Microsoft has gone where the money is and is supporting data-centric ISDN use for Internet access.

Multiple APIs for communications under Win 95 is surely not the long-term answer. It only postpones the day when any application can communicate seamlessly over whatever medium is available: LAN, PSTN, ISDN, GSM, or satellite. B

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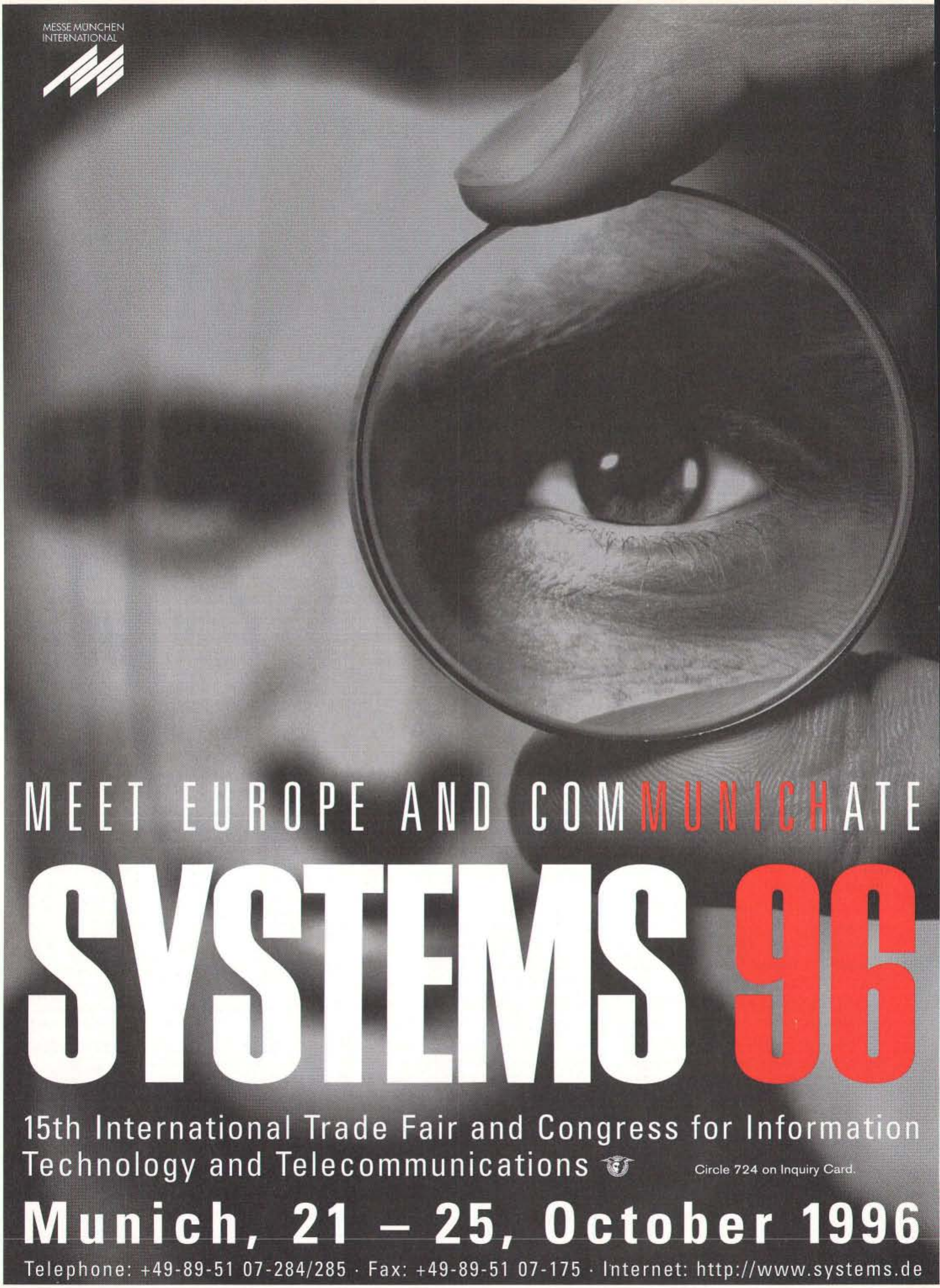

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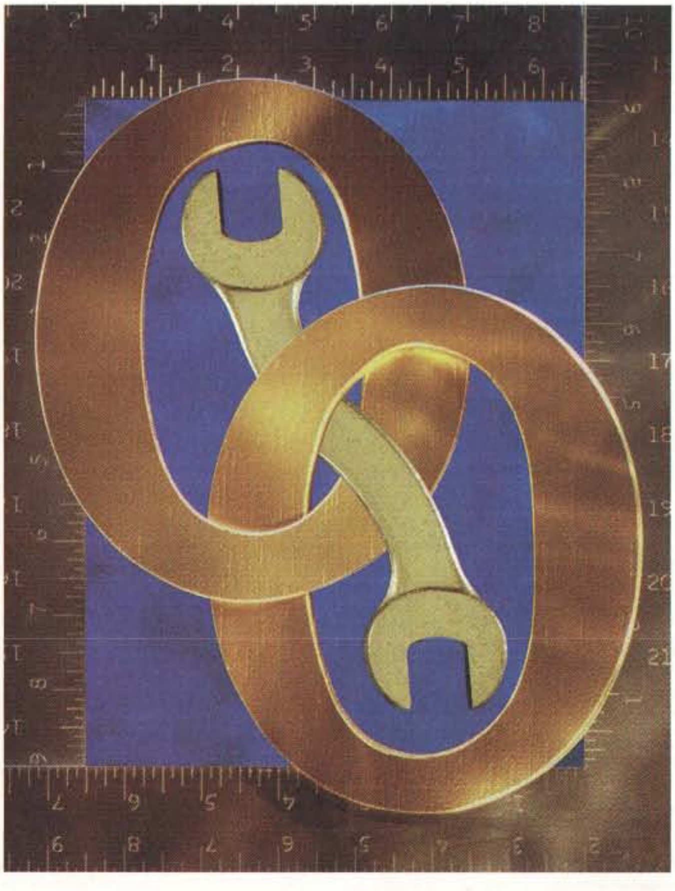
Best CASE Scenario: Choosing OO Methods

Pairing an OO CASE tool to a flexible method can link source code closer to applications design.

By Dick Pountain

The basic idea behind CASE tools is as simple as it is ambitious: Support the whole development process through a graphical notation, from analysis of design to implementation, and derive the complete code from the corresponding diagrams. But traditional CASE tools have not delivered on this holistic, model-driven development promise. Though object orientation moves CASE tools closer to this paradigm, developers have yet to effect a fully automated process that can turn specifications into executable programs.

What today's traditional and object-oriented (OO) CASE tools don't have is a methodology that automatically keeps the model and the program in step with each other. However, with most OO methods, it is possible to automatically maintain consistency between the source code and the corresponding data and process diagrams, even when either of them is changed. The actual coding still requires some manual intervention.



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OO CASE Methods

A key feature shared by all OO-programming (OOP) systems is that they recognize a clear distinction between data (objects) and action on that data (methods), and most of them encourage the reuse of both data structures and actions through inheritance. OO CASE tools exploit this clean separation by using two kinds of models to specify a system.

The *object structure model* describes which objects will appear in the system (and their attributes and relationships that persist over time). The *object behavior model* describes the way the objects respond to external events and how their states change as a result.

The object structure model corresponds fairly closely to the data-modeling function of older CASE tools, which was their most successful aspect. In this first step of a development project, you draw diagrams that connect real-world objects and their relations (typically, customers and orders) with class hierarchies.

In such diagrams, each symbol representing an object can have several internal slots that represent named attributes (e.g., customer ID or address). Such diagrams map easily onto the syntax of such typical OOP languages as C++, Smalltalk, and Visual Basic 4. Therefore, almost all OO CASE tools are capable of automatically generating class templates that have all the necessary data declarations already in place.

Finding the Right Model

The object behavior model, which describes the processing that the system performs, is more complicated to produce, and the variety of techniques employed is far wider than in data modeling. The most important techniques are *state-transition modeling*, *event-flow modeling*, *use-cases modeling*, and *responsibility-and-collaboration modeling* (see the text box "Behavior-Modeling Techniques" on page 40IS 13).

It's not as easy to translate behavioral diagrams into method code as it is to translate data diagrams into class templates. Most of the OO CASE tools that perform code generation have to insert much meta-information—in the form of specially formatted comments—into the generated code. This can make it more difficult for programmers to understand the source code and may mean that large expanses of the code are declared "do-not-touch" and must not be modified manually. Furthermore, most of the OO

CASE tools generate only the prototypes for C++ member functions, leaving their code bodies to be added manually.

Often, none of these behavior-modeling techniques are strong enough to be used on their own, and OO CASE methods tend to apply two or more of them in conjunction to provide different views of the model. State transition and event flow seem to be more favored for modeling real-time and embedded systems (or telecommunications networks). The plain-language descriptions of use cases are especially suited to business applications, where end users must understand the notation used to model their working practices. However, because use cases can also be less precise, they are frequently assisted by a more rigorous method (e.g., an event-flow chart).

The OO-Method Confusion

More than 50 OO-code design methods make tool selection a real Babel and split the developers' community into camps of believers and nonbelievers in a certain methodology. Named mostly after their authors, they combine some of the data- and behavior-modeling methods mentioned above.

Some of the better-known design methods are Rumbaugh's Object Modeling Technique (OMT), the Booch Method, Jacobson's Use Cases, Shlaer/Mellor's Object-Oriented Analysis (OOA), Martin/Odell, Coad/Yourdon's Object-Oriented Analysis and Design (OOAD), and Wirfs-Brock's Responsibility-Driven Design (RDD).

Because of these vying methods, many OO CASE tools support three or four of the most popular to serve different camps. Other tools include sophisticated metamodeling facilities that let users create and maintain new design methodologies or customize the notation used by an established method to support their own needs. At the upper end of the market, tool vendors sell consultant services and training along with software in order to help developers cope with the sheer proliferation of OO methods.

Another approach to make the tool market more transparent is the current collaboration of the authors of three of the leading methods—James Rumbaugh, Grady Booch, and Ivar Jacobson—to produce a single *Unified Method* that will be launched later this year. If vendors decide to accept the Unified Method as a standard, chances are good that the OO development community will be less fragmented soon.

Anatomy of an OO CASE Tool

A typical OO CASE tool setup is based on a shared repository that contains all the components of the model being built (i.e., the graphs, diagrams, and the internal representation of the model). Some products store this repository data in a proprietary format; others implement it using industry-standard relational or object database engines.

The programmer can view the contents of the repository via editors or browsers to create the analysis and design diagrams, which may include object-structure, data-flow, event-flow, process-hierarchy, state-transition, and collaboration diagrams. Also plugged into the repository are report generators and documentation tools, and an interface to the compiler and development system for the OO language being used to implement the project.

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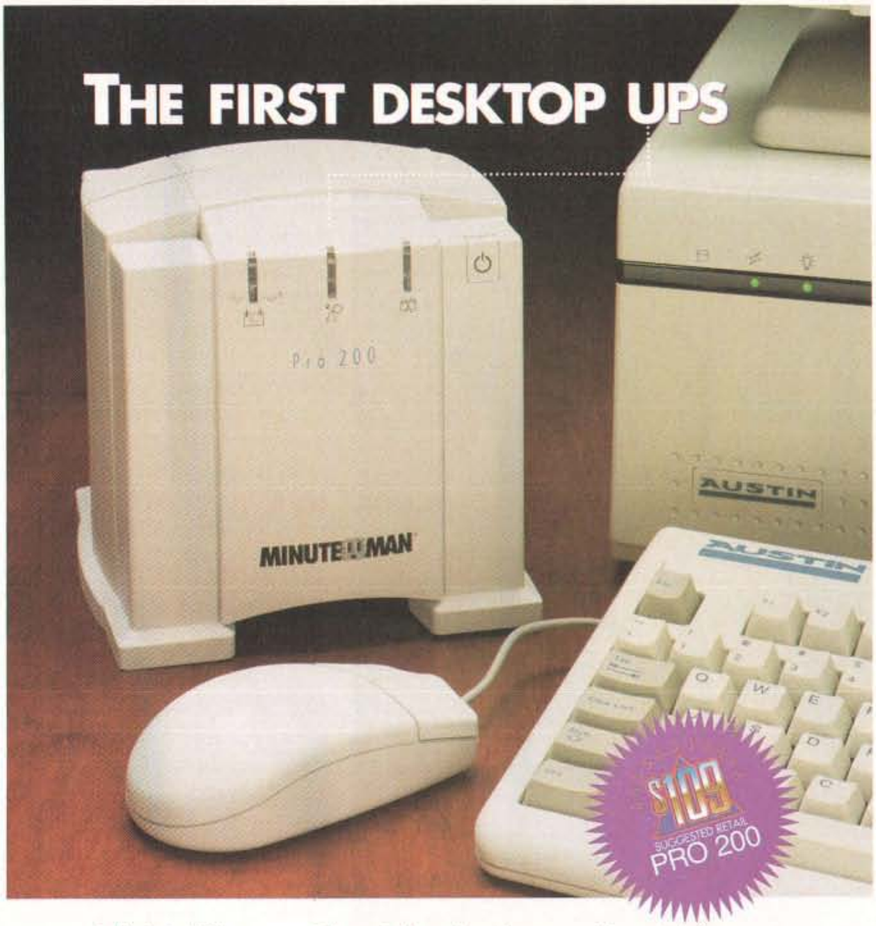

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most OO CASE tools—which brings them closer to the model-driven development paradigm—is some degree of reverse-engineering ability. This means that they can take the source code for an existing project (in C++, C, Smalltalk, SQL, or sometimes even COBOL) and extract from it an object model that can then be edited and used to further modify the system or build a whole new system. Some OO CASE tools also maintain bidirectional *live links* between the source code and the model (i.e., any changes that are made to the source code will be reflected in the model and vice versa, a feature that is often called *round-trip engineering*).

One of the most widely touted advantages of using object technology is that it corresponds more closely to the real world than do other programming paradigms. This means that you can, in principle, describe systems in a language close to natural language: Take an English (or French, or German...) sentence that describes a transaction, pick out the nouns to become your objects, the adjectives to become their attributes, and the verbs to become member functions (in C++) or methods (in Smalltalk). If you choose your sentences wisely, this procedure does indeed work, and several OO methods are based on it. One of these methods is HOOD from the European Space Agency.

Behavior-Modeling Techniques

Behavior modeling is the more complicated part of the design process with CASE tools. The majority of tools use one of the following techniques:

State-transition models treat each object as a state machine that can be in one of a number of possible states, and which external events can drive from one state to another.

Event-flow models describe the way that events flow between objects, in the form of charts with a time axis. These diagrams show the response of each object in the system to receiving a particular event at a particular time. A widely used event-flow notation is the Message Sequence Chart (MSC) defined by the ITU's Z120 standard.

Use cases and scenarios are textual descriptions of what the system is supposed to do from the point of view of a user (e.g., "Enter the customer ID, and the customer address appears in Form 1").

Responsibility-and-collaboration modeling describes the relations between objects in contractual terms; which groups of objects will collaborate and what tasks each is responsible for performing on behalf of the others.

KISS (which stands for Kristen Information and Software Services), a method invented by Gerald Kristen, takes this idea further. It starts from a natural-language

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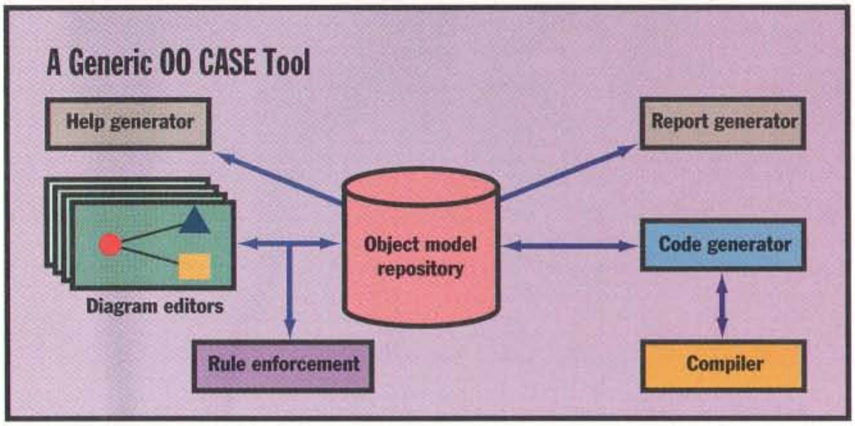
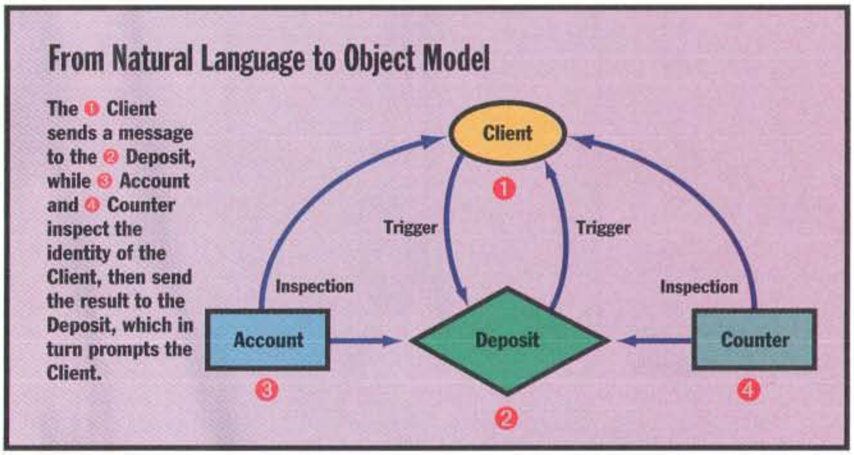
textual description of the system and performs a grammatical analysis on it to extract subjects, predicates, active objects, passive objects, prepositions, and other parts of speech; all these entities translate into types and classes in the KISS object model.



A generic OO CASE tool is based on a central repository holding the object model.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①
Trigger
Trigger
Inspection
Inspection
Account
Deposit
Counter
③
②
④

The KISS method converts natural language (here, the client deposits into an account at the counter) into object specifications.

Using these entities, KISS goes through a 12-stage process that involves analyzing communication between subjects and work flow and then creating a succession of models in which each model works on the previous one by adding more detail or removing ambiguities. The process culminates with designs for screens and reports.

Obviously, a program specification modeled by KISS can easily be understood by people who are not computer-literate enough to understand graphical notations. Another advantage of KISS, according to a Butler-Bloor report about OO methods, is that it "creates a logical model that is both more semantically complete and more semantically accurate than other OO methods," but at the price of being more prescriptive and less casual than some others. However, at present, only Paradigm Plus from ProtoSoft (Houston, TX) supports KISS among other methods.

Different Views on One Model

Another method that has some advantages but that hasn't been accepted too widely is Trygve Reenskaug's OOram. Reenskaug worked at Xerox's Palo Alto Research Center (PARC) in the pioneering days of 1978 and 1979 and based OOram on the Model-View-Controller schema that also underlies Smalltalk. OOram is supported by the CASE tool of the same name from Taskon.

OOram describes a system by a single model, onto which you can take many different views. It allows you to build complex models by combining simpler ones in arbitrary ways, with the advantage of not being confined to simple hierarchies. OOram offers a total of six views onto a central object model—collaboration, semantic, scenario, process, finite-state machine, and methods specification. Each one is represented via a different diagram tool. The system supports development in these languages: Smalltalk, C++, Eiffel, and SDL (see "RAD for Real-Time Apps," May BYTE International). It offers round-trip-engineering facilities from these languages.

CASE Tool for Visual Basic 4

One of the first OO CASE tools that is based on Microsoft's Visual Basic 4.0 and OLE Automation is Select Enterprise, from Select Software. The product is available in two different versions. One generates Visual Basic; the other one generates code for Forte, which is an OO fourth-generation language (4GL) for client/server development. The VB version also generates SQL DDL and C++ header files and skeleton implementation files, and it can reverse-engineer from C++ code to produce a "first-cut" model that captures attribute and operation names and inheritance trees. Select Software says that more generators for Delphi, PowerBuilder, and SQL Windows will come soon.

Select Enterprise supports Rumbaugh's OMT method in combination with Jacobson's Use Cases and a Business Process Modeling facility that works from organizational structure charts. There are several add-on tools for Select Enterprise, including an object animator that lets you step through a Jacobson interaction diagram and shows the objects involved in each use case as pictures, with marquee-style moving lines representing the messages between them.

Select Enterprise stores its object model in an OLE-based repository so that any software that supports OLE Automation (e.g., Word or Excel) can have read and write access to the model data. Select Enterprise invokes the VB development environment to allow you to partition the application that's under construction into components (forms and skeleton class definitions), which get registered as OLE objects. You can reverse any changes that are made to the VB code back into the model, but this synchronization is not automatic and does not transfer type information.

Create Your Own Method

The Finnish company MetaCase Consulting describes its MetaEdit+ product as "the chameleon of CASE tools," which accurately pinpoints the program's strongest feature: It can support all existing OO design methods and enables you to create new ones. The tool comes with predefined support for 12 OO-, structured-, and business-modeling methods, including OMT, Booch, Fusion, OOA, and OOAD.

Its method-modeling editor lets you combine elements of these methods or devise completely new ones by defining graphical diagrams from which code definitions are generated to be compiled by a method compiler. MetaEdit+ includes a generic diagram editor for drawing all sorts of graphs, and matrix and table editors for handling design information as tables or forms. MetaEdit+ is written in Visual Works Smalltalk and comes with predefined code generation for Smalltalk and C++. However, you can modify the report browser to generate other target languages.

PRODUCT INFORMATION

KISS and Paradigm Plus
£4000
Kristen Information and Software Services
Veghel, The Netherlands
+31 413 35 03 30
fax: +31 413 35 19 52
Circle 979 on Inquiry Card.

MetaEdit+
Starts at $4500
MetaCase Consulting
Jyväskylä, Finland
+358 41 650 400
fax: +358 41 650 405
http://www.jsp.fi/metacase
Circle 980 on Inquiry Card.

Object Engineering Workbench for C++ and Java
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Innovative Software
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fax: +49 69 236930
http://www.isg.de
Circle 981 on Inquiry Card.

OOram
$950 for a single-user version; about $6000 for the professional version
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fax: +47 22 60 44 27
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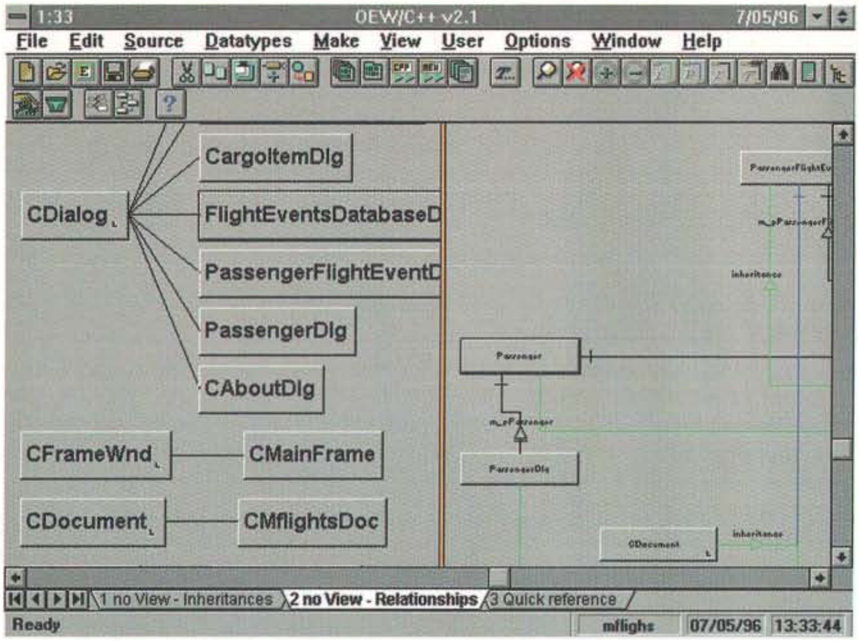

Object Engineering Workbench lets you model object relationship diagrams hot-linked to the class inheritance hierarchy diagrams.

Focus on the Source Code

Object Engineering Workbench (OEW) for C++ and Java is not exactly a full CASE tool. It is closely centered on the project source code. It takes all parts of a C++ project—including header files, include files, and class libraries—and produces from them an object model of the whole project, using a sophisticated C++ parser that lies at the heart of the product.

OEW lets you add objects incrementally to a project, and its powerful parser enables it to reverse-engineer external class libraries. It offers two graphical views onto the internal model, an abstract view called the object relationship diagram, and a separate window that shows the class inheritance hierarchy diagram. Both these views are hot-linked to the source code window, and you can edit the structure of a project by dragging and dropping classes, member functions, and slots between any of them, while OEW automatically keeps the views in sync.

Additionally, it automatically generates C++ headers and method templates from symbols you add to the object relationship diagram, and it enables you to complete writing the method bodies within the same environment. Though OEW doesn't currently support any CASE method, its object relationship view is based on an OO extension of entity-relationship modeling. However, Innovative Software announced that OEW will support the Unified Method and become a full CASE tool by the end of the year.

A Hard Choice

Given the size and depth of these products, choosing an OO CASE tool cannot be an easy matter. There is no simple way to prescribe which method is most likely to prove suitable for a particular job. Adopting a full-blown OO CASE method means abandoning casual and ad hoc analysis and design practices, which may require a large change in the programming culture of an organization. But the rewards far outweigh the inconvenience.

Over the next few years, we will see a degree of object-modeling ability beginning to appear within the integrated development environments (IDEs) of such languages as C++ and Smalltalk, and applications generators like PowerBuilder. The same is true for such visual programming languages as Microsoft's Visual Basic and Borland's Delphi, which are taken even more seriously for large-scale client/server applications. In this case, OO CASE tools without code-generation capabilities will be hard to sell. **B**

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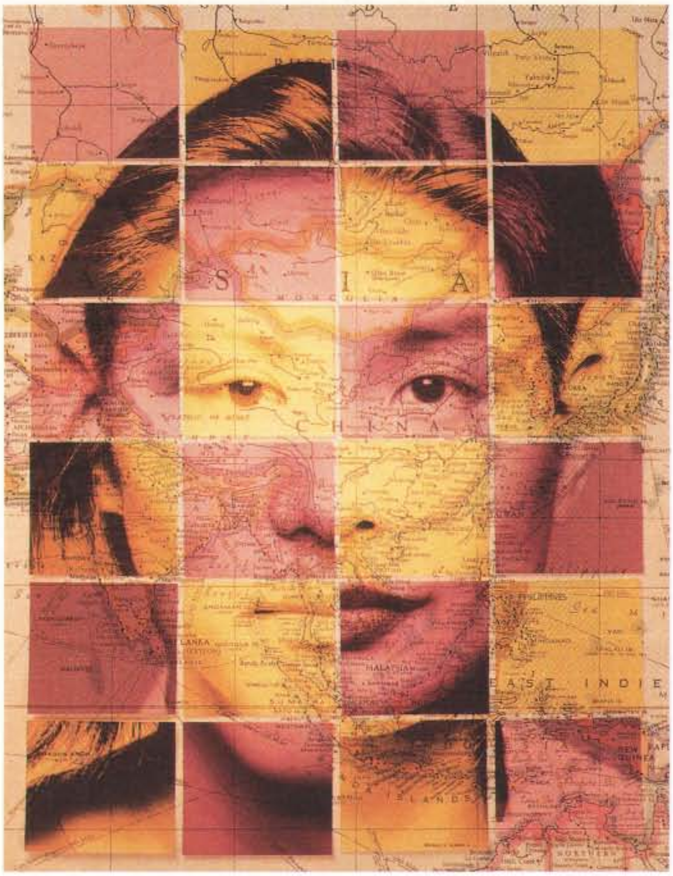
Asian Internet Fever

Pent-up demand strains the infrastructure.

By Mark LaPedus

In the early part of this decade, many countries in Asia began to formulate plans to build their own wide-scale information networks. With the ability to gain access to the Internet, many nations are now constructing parts of what they hope will become a commercially successful Asia-wide information superhighway.



At present, few backbones extend between Asian cities. About 80 percent of Asia's Internet traffic is first routed to servers in the U.S., then bounced back to the region. Furthermore, most Web sites are still situated in the U.S.

Asian Internet users routinely suffer connection delays and data traffic jams—even in the most advanced nations, not to mention developing countries that have outdated phone systems and networking schemes. To alleviate these problems, several Asian carriers and regional Internet service providers (ISPs) have recently formed alliances to install the first high-speed, meshed backbones in the region.

Backbones currently being deployed in Asia include:

- A consortium led by Hong Kong Supernet, Singapore's Pacific Internet, Japan's Sumitomo, and the Internet Initiative of Japan (IIJ) announced last spring an Asian backbone, dubbed ABONE. The group is setting up T1 and E1 links that run at 1.544 Mbps and 2.048 Mbps, respectively.
- Both T1 and E1 lines connect a recently formed group led by Japan's CSL and KDD, Hongkong Telecom, Macao's CTN, Singapore's Singnet, and Taiwan's Directorate General of Telecommunications (DGT). Links are also planned for Australia, China, Malaysia, the Philippines, and Thailand.
- AT&T, KDD, and Singapore Telcom announced plans to set up an asynchronous transfer mode (ATM) trial in Asia.
- AT&T, IBM, and Global One are expanding their own private backbones in Asia.

More links are expected. But not all, if any, of these links will connect to other backbones, nor is there a sign of compatibility, analysts say. Still, the move to deploy these backbones in Asia will help alleviate the U.S.-centric topology, says Nicholas Lee, chief executive of Pacific Internet, one of Singapore's largest ISPs and a member of the ABONE consortium.

"In time, the use of the Internet will double or triple in Asia," Lee says. "What's going to happen in the next five years is that the ratio of Internet data moving from Asia to the United States will be reduced from 80:20 to 70:30, and perhaps 60:40 in the years to come." Commerce and trade will drive this trend, he adds.

It will take some time before Asia is capable of supporting electronic commerce through the Internet, but businesses are certainly aware of the potential. The worldwide Internet market (with World Wide Web access) is projected to grow from 8 million users in 1995 to 80 million in 1997, according to figures from U.S. Internet software supplier Aimnet. Asia's Internet end-user base could grow from around 2.1 million in 1995 to more than 6.5 million in 1997, Aimnet projects. This is based on the estimated number of users in China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, Thailand, and Taiwan.

Not every Asian nation will benefit from the Net. Many lack digital phone lines or circuits to support Internet connectivity. Some cannot afford it: A T1 connection, if available, runs $15,000 per month. Necessary equipment starts at more than $30,000. Japan is the most advanced regarding Internet usage, with more than 300 ISPs serving 1.6 million users last year, according to Aimnet. In contrast, Vietnam's Internet base is estimated to be 300 users, with the government the sole ISP.

Another limiting factor is language. English is the de facto standard on the Internet, but one-third of the world's popula-

ILLUSTRATION: ALLEN WALLACE © 1996

tion uses character-based languages, many of which are not supported on the Web. There's a push to support Chinese, Japanese, and other languages. "Chinese content on the Internet is increasing, but Japanese is ahead of the game in Asia," says Philip Wong, chief executive for Asia On-Line, a large Hong Kong ISP that specializes in developing Asian-language content on the Web.

How content will develop in certain countries is an interesting issue. It's well documented that officials in China and other countries view the Internet as a threat to social order. Any Chinese citizen who signs up for access must register with the local police and promise not to commit crimes against the state.

The Sleeping Giant

Countries in the Greater China region (China, Taiwan, and Hong Kong) are working to solve some basic communications issues. China and Taiwan, for example, do not have direct sea, air, or telecommunications links. Phone calls from Taiwan to China are diverted from the island to two long-distance carriers, either Japan's KDD or Hongkong Telecom. Internet traffic from Taiwan to China usually goes from the island to U.S. Sprint's office in Stockton, California, and then bounces back to gateways in China.

China is deploying an ambitious backbone to link the entire nation of more than 20 provinces, but it's unlikely in the near term that most of the country's 1.1 billion people will ever use—or hear about—the Internet. There are two types of backbones deployed in China: commercial and academic. The most ambitious academic faction is the China Education and Research Center (CERNet), which plans to connect all of China's universities, institutes, and grade schools by the year 2000. CERNet is developing its own private backbone.

Total Internet Users in Asia

	1995	1997
Japan	1,600,000	3,500,000
South Korea	100,000	525,000
Malaysia	100,000	495,000
Singapore	100,000	495,000
Taiwan	70,000	480,000
Thailand	35,000	140,000
Hong Kong	32,000	423,000
Philippines	20,000	150,000
Indonesia	10,000	100,000
China	15,000	200,000

The commercial sector is also ambitious. In late 1994, China's Ministry of Posts and Telecommunications (MPT) began to deploy a public data network backbone. The network, called the China Digital Data Network (CDDN), is basically a fiber-optic link between Beijing, Guangzhou, and Shanghai. CDDN was supposed to be completed this summer, but some observers believe the backbone will not be totally operative until late this year or beyond. There is currently a fiber-optic link between Beijing and Shanghai, as well as a separate line in limited use. In the works is a fiber-optic line from Shanghai to Guangzhou.

CDDN is linked into China's provinces. From there, CDDN is allocated or "split" into packet switching, Internet, or telephony services. Each provincial telecom is in charge of developing and providing its own backbones and services within the province.

To talk to the outside world, Beijing and Shanghai have separate (and reportedly the only) gateways. Shanghai has an E1 link that extends to U.S. Sprint in California. Beijing has a 256-Kbps link to U.S. Sprint and a recently installed "split E1" line to MCI in the U.S.

China Internet Corp. (CIC) also has its own regional backbone, dubbed CICNet. CIC has a 64-Kbps leased line that runs from Hong Kong to Guangzhou, which serves as the Internet-access backbone for its customers in China.

CIC broadened its capacities and customer base in May by adding an Internet link with southern China's main carrier, the state-run Guangdong Post and Telecommunications Administration (GPTA). GPTA had launched GNET, a regional backbone in the Guangdong province, in late '95. By this spring, GNET had two separate E1 links from its hub in Guangzhou to a pair of southern Chinese

Southeast Asia Plays Catch-up

India and Vietnam struggle to upgrade their phone infrastructures.

One of the fastest-growing markets for the Internet is Southeast Asia, an area that covers India and Indonesia and other huge nations. Leading the way is Singapore, a city-state of only 2.8 million people. Of course, it's easier to wire a city-state than, say, India, a country with 900 million people and a notoriously bad phone system.

Singapore's three Internet providers–Cyberway, Pacific Internet, and SingNet–have completed the work on their own private backbone that will provide faster service to the nation's 100,000 users. Called the Singapore Internet Backbone, the network is a single E1 (2.048-Mbps) line. In simple terms, the circuit will consist of a link from SingNet to Pacific Internet, one from Pacific Internet to Cyberway, and a third from Cyberway to Singnet, say officials at Pacific Internet, which previously had a 128-Kbps link to Singnet.

Aside from Singapore, Southeast Asia's Internet base is small because "PC penetration in the region is very low," according to Janardan Menon, an industry analyst at Dataquest-Singapore. "India has only two ISPs, but the nation is starting to develop a lot of Web sites," he says.

Indonesia, a country with more than 180 million people and more than 13,600 islands, had only one ISP two years ago; today, it has 20, sources say. Indonesia's Internet market is expected to jump from 10,000 users in 1995 to 100,000 in 1997, according to Aimnet, an Internet software developer. Indonesia's largest ISP is Radnet. Working closely with PT Telkom and PT Indosat, the nation's state-run local and international carriers, respectively, Radnet offers various services, including simple dial-up shell accounts, SLIP/PPP dial-up accounts, and connections of 2 Mbps.

Other nations are getting into the act, including Malaysia, Thailand, the Philippines, and, surprisingly, Vietnam, a nation of some 74 million people and a per-capita income of only $180 per year. Vietnam's telecommunication authority, Vietnam Posts and Telecommunications (VNPT), will spend nearly $3 billion over the next few years to develop its phone infrastructure. One of the goals is to complete a fiber-optic network that connects the nation's 53 provincial centers. U.S. Sprint last year signed a deal with VNPT to set up and manage Vietnam's information superhighway, a program known as IT2000.

In 1994, there were only 30 Internet users in Vietnam. By 1995, the number had grown to 300. Vietnam's state-run Information Technology Institute is the gateway to the Internet in the nation. Vietnam's ISP, Netnam, charges a one-time fee of $20, plus $60 for the first two months of service.

Double-Byte Languages

Searching for information is sometimes doubly difficult.

English-language software is written in what's called single-byte code. In contrast, Chinese, Japanese, and other character-based software products are written in double-byte code. "Double-byte code, as the name suggests, consists of bytes that when put together make a single character, as used in many Asian languages," explains Dion Wiggins, director of strategic development for Asia On-Line, a Hong Kong-based Internet service provider (ISP) that specializes in furnishing content in Chinese, Japanese, Thai, and other Asian languages.

Double-byte software, however, is sometimes more expensive than single-byte packages. Plus, it poses problems in machine translation with single-byte-based systems, says Hong Chen, chief executive of Aimnet, which develops Internet software.

Adds Wiggins: "When searching English data [on the Internet], you can search for part of a word. But this is not possible with double-byte character sets as the characters themselves are the whole word."

Asia On-Line is developing a search engine based on neural network technology. "Neural networks learn from patterns and events, so when the same or even a similar event happens, it can make decisions based on previous events. If you apply this technology to a search facility, it can be used for any language, including all double-byte character sets and English," Wiggins says.

cities: Foshan and Shantou. By the end of this year, GNET plans to connect into 23 cities in the southern province of Guangdong, according to Aaron Y.T. Cheung, vice president of network technology and operations for CIC.

CDDN "is a generic, nationwide backbone, while CNET is a regional backbone built around a star-based networking topology," Cheung says. CIC will use the CNET as "an intranet in a large sense of the word," he adds. "It's a private network for corporations, our major focus." CIC, whose corporate customers are based in Hong Kong and China, claims CNET will help serve as bridge between Hong Kong and China-based trade. But some analysts wonder if CIC is really the gateway—or the gatekeeper.

Government Censorship

Some countries block "politically sensitive" information.

The Asia-wide backbone will boost Internet access and commerce in the region, but it has the potential to also bring more government censorship. Asian Internet service providers (ISPs) in some nations already use filtering techniques to block "illegal addresses" containing material judged to be pornographic or politically sensitive. But regional backbone links between nations will certainly provide better security controls to check for "Internet abuses," according to one ISP in the region.

Some governments are even setting up their own ISPs to control information. China Internet Corp. (CIC), a Hong Kong-based provider run by China's official mouthpiece, the Xinhua News Agency, was launched late last year by the government to be a gatekeeper in China. CIC, which is expected to have more than 200,000 subscribers in China by the end of the year, provides information on trade in China for the outside world, but it blocks or "filters" allegedly obscene content, on-line services of exiled Chinese dissident groups, and other political material.

Today, there are only 10,000 commercial Internet users in China, analysts say. Those who sign up for commercial services must register with the local police within 30 days of access. Commercial access in China is pricey. Roughly speaking, China's ISPs charge over $70 per month. However, most people in China barely make $40 per month.

China's ISPs, including ChinaNet, CIC, and others, are all run by various government agencies. No foreign ISPs are allowed. Hong Kong-based CIC, for example, is run by the Xinhua News Agency, China's official mouthpiece. CIC, which serves 30 provinces in China, also has a home page complete with databases to help "facilitate trade" with the country. CIC's databases, which include information on travel, freight, and even home shopping, is on the Web in both Chinese and English.

Hong Kong Is Wired

Hong Kong's wheeler-dealer tradition extends to cyberspace. More than 60 ISPs of all shapes and sizes have emerged in Hong Kong—just in the last 24 months. There are four to six major ISPs serving more than 100,000 users, says Adam Judd, business manager of North-South Asia for Bay Networks. The remaining ISPs are smaller outfits, many of which operate out of their houses with a server, modem, software, and only a few accounts.

A large percentage of the ISPs in Hong Kong lease bandwidth from AT&T, Global One, Hongkong Telecom, and IBM. Hongkong Telecom, for example, basically runs the Hong Kong Internet Exchange (HKIX). It provides interconnection capabilities to the colony's ISPs; however, some Hong Kong providers have their own backbones.

To the outside world, Hongkong Telecom also has an E1 and 512-Kbps line extending to its parent company, Britain's Cable & Wireless. Cable & Wireless, in turn, has a 10-Mbps link to the U.S. Hongkong Telcom is also part of a group that is building an Asian backbone. Separate E1 links have been recently deployed from Hongkong Telecom to Japan's KDD and CSL Japan. A 128-Kbps line runs from Hongkong Telecom to Singnet, an ISP owned by Singapore Telecom. An E1 link to Singnet is on the drawing board. (Singapore Telecom plans three E1 links and a T1 links to the U.S. and runs the Singapore Telecom Internet Exchange regional network, which has 14 ISP customers in Brunei, Indonesia, India, the Philippines, and Vietnam.) There are separate links from Hongkong Telecom to the phone carriers in Macao and Taiwan.

Hongkong Telecom is working on various links with Australia's Connect.Com, China's MPT, Malaysia's JaringNet, as well as undisclosed parties in the Philippines and Thailand. Last April, Hongkong Telecom stunned the market when it became an ISP. (Previously, it offered only leased lines to customers.) Hongkong Telecom's Internet service will come in three phases. Initially, the service will provide not only access but will offer information and other services to its customers. Next, the company will focus on developing local content.

"The third phase will come in August when our customers can start doing their daily shopping from our electronic commerce offerings, as well as other interactive offerings," says William Lo, managing director for the company's ISP organization, Hongkong Telecom IMS.

Other ISPs in Hong Kong are unhappy. Hongkong Telecom's prices undercut the competition, many claim. Initially, Hongkong Telcom's ISP services run $6 per hour during nonpeak hours (not including local access fees). In contrast, one major ISP said it is charging $10 per hour (not including access fees).

Competitive ISPs are not standing still. Many are expected to wage a price war against Hongkong Telecom. Such a war could put the smaller providers out of business. Other providers are moving on a different front to become more competitive. Asia On-Line, one of Hong Kong's largest ISPs, recently expanded its base by purchasing a majority stake in Pristine, a small Taiwanese ISP. The new company, called Asia On-Line Taiwan, gives Asia On-line a foothold in the large Taiwan market, says chief executive Wong.

Hong Kong Supernet, one of the colony's largest ISPs, also has ambitious plans. It is part of the recently formed consortium that is constructing the ABONE, which consists of separate T1 and E1 links from Hong Kong to Japan and Singapore to Japan, respectively. Sumitomo and IIJ are administering the links. There is an E1 connection in place between Hong Kong Supernet and Pacific Internet. Future links are being planned to run between Japan and Australia.

Taiwan's Lack of Bandwidth

Unlike Hong Kong, Taiwan's major problem in terms of commercial Internet access is lack of bandwidth. Taiwan currently has four major ISPs, including two government-sponsored organizations and some smaller, independent companies. One user reported that he was able to get only three connections in as many months of service from Taiwan's largest ISP, dubbed HiNet, which is run by the DGT. Taiwan's academic community has been shielded from this. TaNet, a government-sponsored, academic-oriented network, has its own T1 line running from the island to Princeton University.

Late last year, Taiwan deregulated its telecommunications industry. The move opened the market up to some new and powerful ISPs, including IBM and Taiwan's two largest PC makers, Acer and First International Computer. Still, Taiwan's commercial Internet base is expected to more than double to 150,000 users by next year, prompting some chilling thoughts among the island's subscribers: more and more gridlock. Most blame the island's on-line congestion on HiNet. At present, HiNet has more than 70,000 customers, but up until recently, it had only a single T1 line running to the U.S. HiNet claims it has recently added another T1 line. Still, there's a problem: The island's four or so other major ISPs do not have their own backbones; instead, they must lease bandwidth from HiNet, which is already bursting at the seams.

"We don't think Taiwan's network topology is reasonable," says Daniel Ongg, vice president of the Network Business Group for the government-sponsored Institute for Information Industry (III, in Taipei). III runs Taiwan's second-largest ISP, called SeedNet, which has a T1 line into HiNet. SeedNet hopes to spin off its Taipei-based ISP into a commercial

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Custom Intranet Services

Paving the way for electronic commerce.

Electronic commerce over the Internet could reach an annual level of $150 billion by the year 2000, some analysts say. Electronic commerce is in the embryonic states in Asia, but many companies are gearing up their intranet-based services or private-access networks for businesses.

This summer, for example, Pacific Internet, a Singapore-based Internet service provider, will be in full swing with services that the company says are up to nine times cheaper than the competition. These services will include personalized ISDN access, ISDN leased lines, FTP servers, and, of course, firewalls to protect customers.

On the software side, Ziran later this year should be in production with its intranet solution, called the Ziran Internet Communicator for Asia (ZICA). ZICA is an input system that will allow businesses to access Web sites in Chinese, including the traditional character set used in Taiwan, the simplified version used in China, and the slightly different flavors used in Hong Kong, Korea, and Japan, says Eric Chappell, Ziran's managing director. ZICA runs on the PC and the Mac and includes a Chinese-language browser, input system, e-mail, and search engine.

Sun Microsystems is working with the Chinese University of Hong Kong on a Chinese version of Sun's HotJava browser. Other Chinese-language packages are expected to surface later this year.

company this year or next, Ongg adds.

New ISPs, including IBM, will undoubtedly shake up the market. "Our target is the business customer, but we will not overlook the individual," says P.Y. Wang, general manager of Global Communications Network Corp., the Taiwan ISP partner for IBM Global Network. IBM Global Network, which provides Internet services to more than 100 countries, will offer a range of products in Taiwan starting this summer. IBM recently deployed its own backbones in Taiwan, including a 540-Kpbs line to Japan and a 192-Kbps pipe to Australia, Wang says. IBM is currently implementing similar topologies in Korea and Malaysia.

Huge Potential

It will take time before China, Hong Kong, and Taiwan are capable of supporting electronic business on the Internet, but the potential is there. The move to deploy Asia-wide backbones is accelerating Net commerce.

Many giant multinational firms see the potential: IBM, Microsoft, and others are pumping money into Asia's Internet development with a wide range of products and services. Of course, the question remains in Asia as well as the rest of the world: When will anybody start making money from Internet commerce? **B**

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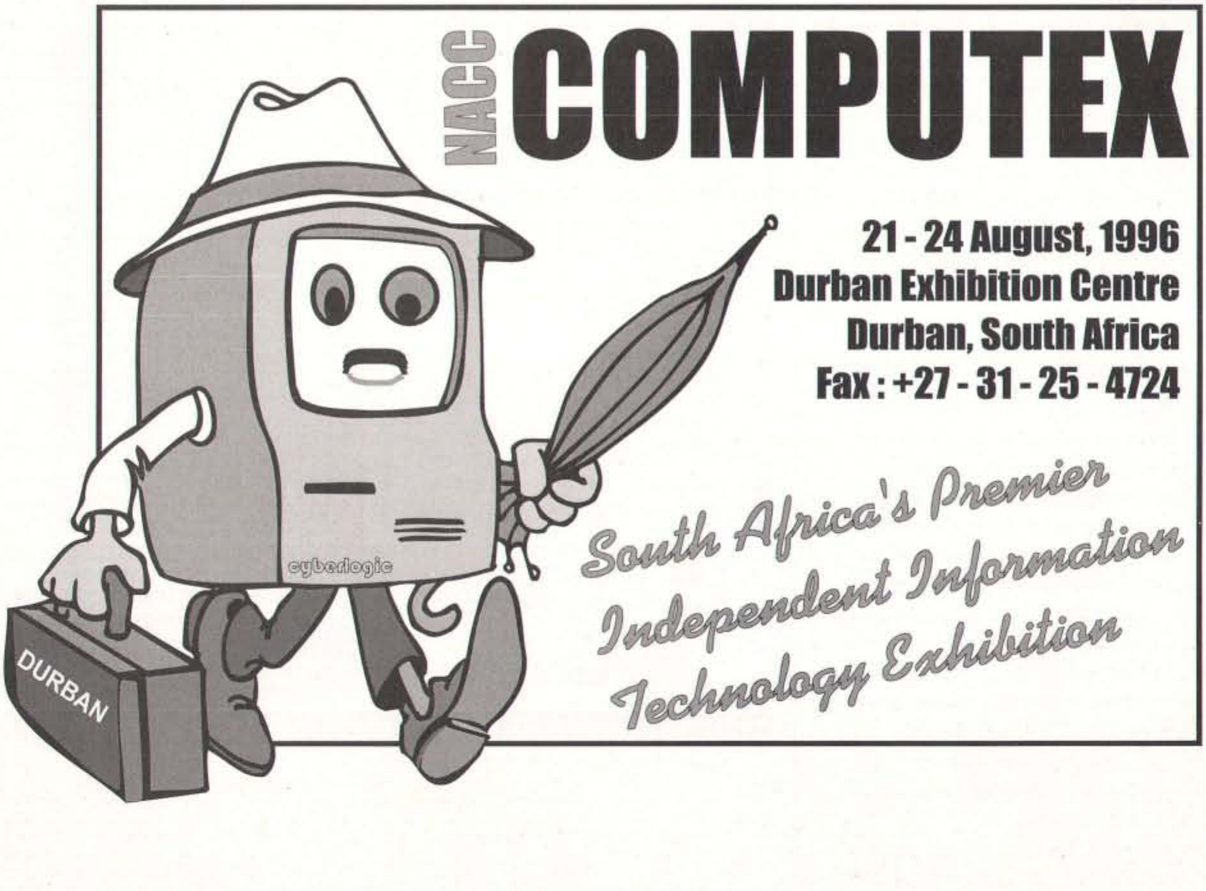
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What's New

Hardware

A double firewall, parallel-processing board, business simulators, and a new way to look at databases.

PREVIEW

MicroLink ISDN/TL V.34
DM 1198

Circle 986 on Inquiry Card.

Elsa
Aachen, Germany
+49 241 9177 0
fax +49 241 9177 617
http://www.elsa.de

ISDN Terminal Adapter with Modem

The MicroLink ISDN/TL V.34 terminal adapter has three important advantages: It connects any computer with a V.24/RS-232 port to an ISDN BRI without any additional driver. Its extended AT command set enables you to use the same communications software you use with your modem. But the best feature is that it automatically detects and sets up ISDN, modem, fax, or voice connections. Thus, by combining an ISDN terminal adapter and a V.34 high-speed modem, the MicroLink ISDN/TL V.34 lets you reach all analog destinations but utilize ISDN's higher bandwidth where ISDN access is provided. It also supports bundling of both ISDN B channels, enabling data transfer rates of up to 128 Kbps.

The MicroLink ISDN/TL V.34 is an external device that connects to a serial port, so it's very easy to install and set up. The drawback is that the data transfer rates depend on your computer's UART and are somewhat lower than with internal boards. Because it is an external device, the MicroLink does not comply with CAPI, so don't expect features such as EuroFile transfer or group 4 fax.

These minor drawbacks aside, the MicroLink adapter is an excellent solution for anyone who wants to connect a PC to both ISDN and the plain old phone system without changing configurations.

–Rainer Mauth

PC Cards

Watch TV on Your Notebook

NOTEBOOK TV, AN EXTERNAL TV TUNER with speaker and antenna, lets you enjoy broadcast and cable TV as well as capture video, sound, and still images on your portable PC. It can capture full-motion video at 30 frames per second at 320 by 240 resolution. The PC Card is compatible with Video for Windows and comes with capture and playback software, as well as videoconferencing software.
Price: Call company.
Nogatech Ltd., Givat Shmuel, Israel, +972 3 5324099; fax +972 3 5324399, http://www.nogatech.com.
Circle 987 on Inquiry Card.

Card Swap

THE SCM SWAPBOX FAMILY OF adapters enables the quick interchange of PC Cards between portable and desktop PCs. The product family includes an adapter designed specifically for Windows 95, a Type III PC Card slot combined with a 3½-inch floppy drive, as well as four-slot products. A set of PC Card and socket services software comes with the hardware.
Price: Call company.
SCM Microsystems, Pfaffenhofen, Germany, +49 8441 8 960; fax + 49 8441 82884.
Circle 988 on Inquiry Card.

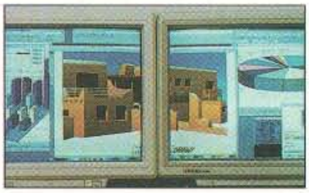
ISDN Board and V.34 Modem

TELELINK'S CARDLINE TWIN INTEGRATES a hybrid V.34 modem and an ISDN board on a single PC Card (Type II). The device is approved internationally and connects to ISDN and regular telephone networks. It works with major flavors of European ISDN protocols such as 1 TR6, Swissnet 2, and EuroISDN and supports V.110, V.120, X.75, and V.42 data compression. The maximum baud rate of the Cardline Twin is 460,000 bps.
Price: Starts at DM 1000.
Telelink, Cham, Switzerland, +41 41 748 1080; fax +41 41 748 1081.
Circle 989 on Inquiry Card.

PCI Display Cards

Multiscreen System for NT

THE NT-WALLX IS A COLLECTION OF high-performance multiscreen graphics systems for Windows NT. The product enables you to control up to six monitors simultaneously. The hardware consists of a single- or triple-channel PCI board with a graphics accelerator chip (Weitek 9100 or S3). Maximum resolution is 1600 by 1280. The NT-Wallx software drivers are NT Workstation 3.51–compatible binaries that run on Intel processors and support automatic cursor handling. Typical applications are GIS and mapping.



Price: Call company.
Dexon Systems Ltd., Budapest, Hungary, +36 1 393 2617, fax +36 1 393 2618.
Circle 991 on Inquiry Card.

Circle 722 on Inquiry Card (RESELLERS: 723).

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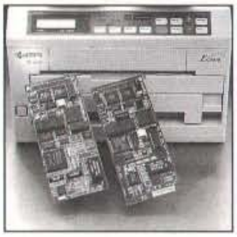

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Fax: +49 / 521 / 444049
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Compuserve Id: 100742,1452

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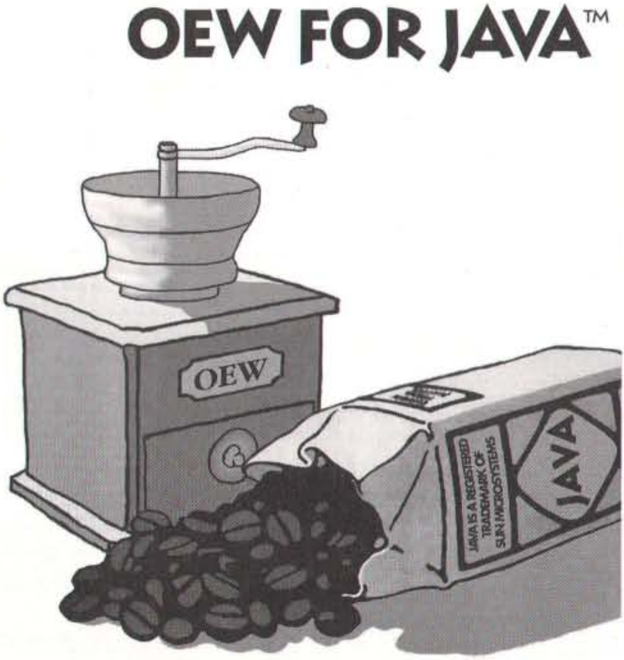
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http://www.isg.de/OEW/JAVA

isg Innovative Software GmbH Germany ✆ +49 69 236929 Fax +49 69 236930

Parallel Processors

Turn Your PC into a Supercomputer

ISATEC SAYS YOU CAN TRANSFORM YOUR PC into a high-performance parallel computer with this PCI board that integrates up to 1024 processors in an instruction systolic array architecture. With this extension board, a standard PC can achieve up to 3200 MIPS and 305 MFLOPS, the company says. The board comes with an extensive library that can be included in C, C++, or Pascal programs; existing DOS or Windows programs can be ported to the architecture by replacing the appropriate routines. The vendor says the system doesn't require an additional power supply or heat sink.

Price: DM 17,250.
Isatec, Kiel, Germany,
+49 431 5606410, fax +49 431 5606419.
Circle 990 on Inquiry Card.

Networking

Ethernet Switch for Big LANs

THE LANBOOSTER IS A MODULAR Ethernet switch that includes as many as 48 ports and can be used as a central switching hub in building-wide and campus networks. The device utilizes the MetaSwitching architecture, which permits collision-free full-duplex operation at all ports at maximum Ethernet speed, according to Siemens Network Systems. To deliver high throughput even at full load, it incorporates an ASIC chip that splits the incoming Ethernet frames into 8-byte cells and then reconstitutes them when they leave the switch. The internal high-speed bus with a throughput of up to 800 Mbps achieves a constant delay time of 40 microseconds.

Price: Starts at DM 12,000.
Siemens Network Systems, Munich, Germany, +49 89 722 33382, fax +49 89 722 28437.
Circle 992 on Inquiry Card.

Double-Wall Firewall for Extra Protection

ZERGO SAYS ITS GFX FIREWALL HAS A double-wall construction: If the outer wall is breached, the inner wall safely and automatically shuts down the link between the walls. The firewall software integrates with all flavors of BSD Unix and supports over 10,000 simultaneous connections. The system includes an administration tool enabling you to manage multiple firewalls across an enterprise network.

Price: Starts at £14,000.
Zergo Ltd., Basingstoke, U.K.,
+44 1442 342600, fax +44 11256 812901.
Circle 993 on Inquiry Card.

Switch Handles 32 Virtual LANs

THE XYLAN PIZZASWITCH IS AVAILABLE in two models: One supports 12 10Base-T connections, and the other handles eight connections that can be of any type of Ethernet. In addition, each base unit can link FDDI, CDDI, or ATM ports. Each PizzaSwitch contains flash memory for code and configuration storage. Features include transparent switching with automatic MAC-layer translation, support of network-wide virtual LANs, IP and IPX routing, as well as graphical support for a range of SNMP platforms. PizzaSwitch can be automatically assigned to 32 virtual LANs.

Price: Call company.
Xylan, Buckinghamshire, U.K.,
+44 1494 510993, fax +44 1494 538984.
Circle 994 on Inquiry Card.

Circle 718 on Inquiry Card (RESELLERS: 719).

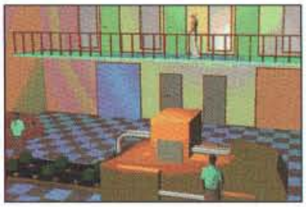
SOFTWARE

Business Modeling

Financial Analyst

INSIGHT, A WINDOWS FINANCIAL ANALYSIS tool, evaluates business performance and identifies the key drivers of profit, cash flow, and returns. One screen shows the dynamic interaction of different business areas, and a targeting tool gives a prioritized list of actions to reach a predefined target.
Price: About $1000.
Pacific Financials, Camberwell, Australia, +61 3 9882 5656, fax +61 3 9882 9376.
Circle 1006 on Inquiry Card.

Business Scenario Simulator



THE NEW VERSION OF POWERSIM 2.5, a program for dynamic business simulations, now includes multimedia features that let you incorporate video and sound into simulations. A run-time version lets you distribute models. With the multidocument interface, you can run several models at the same time. Powersim also supports the partitioning of models, allowing a team to create different components and running models interactively in a network.
Price: Starts at $ 795.
Powersim AS, Isdalsto, Norway, +47 56 342400, fax +47 56 342401, oders@powersim.no, http://www.psiminst.com.
Circle 1007 on Inquiry Card.

Decision Support Tool

VENSIM 1.62 CAN SIMULATE ANY KIND of dynamic system. It includes causality and flow diagrams, an equation editor to model dynamic behavior, as well as tools to analyze results and verify correctness. The software provides an API to incorporate third-party applications. You can generate stand-alone models and run-time versions. Vensim operates on Windows 95 and NT, Macintosh, DEC Alpha, and IBM RS/6000 systems.
Price: DM 795 for Vensim Standard; DM 1995 for Vensim Professional. Simcon, Schwetzingen, Germany, +49 6202 21944, fax +49 6202 26232, simcon@t-online.de.
Circle 1008 on Inquiry Card.

Business Planning Program

THE INTEGRATED PLANNING ENVIRONMENT, a new business planning tool, lets you model financial, personnel, and marketing problems. It accepts incomplete and redundant information, automatically checks consistency, and supports aggregation and disaggregation of information. The program lets you build what-if scenarios and includes modules on production and sales.
Price: Call company.
Information Factory, St. Gallen, Switzerland, +41 71 350 08 44, fax +41 71 350 08 45, Georg.Geyer@IWI.UNISG.CH, http://www.information-factory.ch.
Circle 1009 on Inquiry Card.

Databases

Monitor Documents in Lotus Notes

GRAPEVINE FOR LOTUS NOTES monitors documents in Notes databases by using an organization-specific knowledge chart. The system alerts users about documents that match their personal interest profile. Alert messages contain summary information and a link to the source. GrapeVine provides enhanced support for mobile users, processing of external information, and archiving capabilities. Accord-

Professional Real-Time Tools

RTKernel Real-Time Multitasking for DOS and 16-Bit Embedded Systems

Real-Time Multitasking for:
Borland C/C++, Microsoft C/C++, or Borland Pascal

RTKernel supports:
MS-DOS 3.0 or higher, Embedded Systems without DOS, Paradigm Tools (info available), Turbo Debugger, CodeView

- preemptive and cooperative scheduling
- up to 64 priorities
- your program's functions run as parallel tasks
- Windows can run in parallel with RTKernel tasks
- inter-task communication through Shared Code/Data, semaphores, mailboxes, message-passing
- unlimited number of tasks, about 1K per task needed
- timer rate adjustable from 0,1 to 55ms
- timer with 1 µs resolution
- real-time capabilities through event-driven scheduling
- drivers for screen, keyboard, up to 38 COM ports, IPX services, floppy disks, hard disks, etc.

Developer's License: $550
complete Source Code: add $500
no run-time royalties

RTTarget-32 Cross Development System for 32-Bit Embedded Systems

32-Bit Development System for:
Borland C/C++, Microsoft C/C++, Watcom C/C++

RTTarget-32 supports:
Intel 386/486 EX/SX/DX(2), as little as 16K RAM/ROM

- boot code for floppy, hard disk, EPROM disk
- optional paging and RAM remapping
- FLAT memory model with physical = logical addresses
- program download at 115200 baud
- supports standard PCs and controller boards
- fully supports the C/C++ run-time systems (printf, malloc, etc.)
- interrupt latency <5 µs
- serial communications library
- privilege level 0 or 3
- locator for Win32 PE-files

Developer's License: $1700
complete Source Code: add $1000
no run-time royalties

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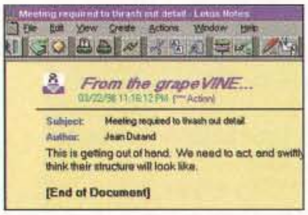
USA	On Time Marketing	(516) 689-6654

Circle 715 on Inquiry Card.


Meeting required to thrash out detail - Lotus Notes
File Edit View Create Actions Window Help

From the grapeVINE...
03/22/96 11:16:12 PM (*** Action)

Subject: Meeting required to thrash out detail
Author: Jean Durand

This is getting out of hand. We need to act, and swiftly
think their structure will look like.

[End of Document]

ing to the vendor, the program doesn't rely on full-text indexes and automatically analyzes the effectiveness of Notes databases.
Price: Call company.
GrapeVine Technologies, Sydney, Australia, +61 2 251 5599, fax +61 2 251 5159, info@au.gvt.com, http://www.gvt.com.
Circle 1010 on Inquiry Card.

WizWhy Detects Patterns in Databases

WIZWHY, A DATA MINING TOOL FOR Windows 95 and NT, reveals rules and patterns in any kind of database. It presents discovered rules either as mathematical formulas or as if-then rules. WizWhy deploys a proprietary algorithm that, in contrast to neural networks, can deal with database inconsistencies and calculates error probabilities. The program comprises direct reading of dBase, FoxPro, Clipper, and Paradox files and indirect reading by means of ODBC. The package includes an ASCII file converter.
Price: $ 3950. WizSoft, Tel-Aviv, Israel, +972 3 5631919, fax +972 3 5611945.
Circle 1011 on Inquiry Card.

Document Managers

Framemaker Administrator

4FRAME, AN ADMINISTRATION TOOL FOR Adobe's Framemaker publishing software, manages text and tables, as well as images in a database, and thus facilitates maintenance and updating of technical documents. Objects that appear multiple times in a project have only one reference in 4Frame's database so that publishing objects can be reused efficiently. The system supports Apple networks and simultaneous access for several different users.
Price: Call company.
CompuTeam, Würzburg, Germany, +49 931 796080, fax +49 931 883895.
Circle 1012 on Inquiry Card.

Multiplatform Management

PROXESS, A 32-BIT DOCUMENT MANagement system for Windows, Unix, and Novell networks, includes interfaces for SAP R/3, Oracle Financial, and Navision PC+C. The system also connects to Digital Alpha-based machines and IBM AS/400 systems. The software is based on an open client/server architecture and can handle SQL queries. Client PCs need at least a 486/33. The program supports CD, WORM, and EOD/MOD archiving. Proxess queries can also be incorporated into other applications.
Price: Call company.
Sattler Hüning Datentechnik, Andernach, Germany, +49 2632 295 456, fax +49 2632 295 333.
Circle 1013 on Inquiry Card.

Internet Tools

4GL Tool for the Web

SUPERNOVA FOR THE WORLD WIDE Web extends three-tier client/server and on-line transaction processing to the Internet and Web. It dynamically creates HTML code and thus enables application access via standard browsers. The system is Java-compatible and runs applications over the Internet without change or recompilation.
Price: Call company.
Four Seasons Software, Bilthoven, The Netherlands, +31 30 2252315, http://www.4seasons.com.
Circle 1014 on Inquiry Card.

Server for Indexing

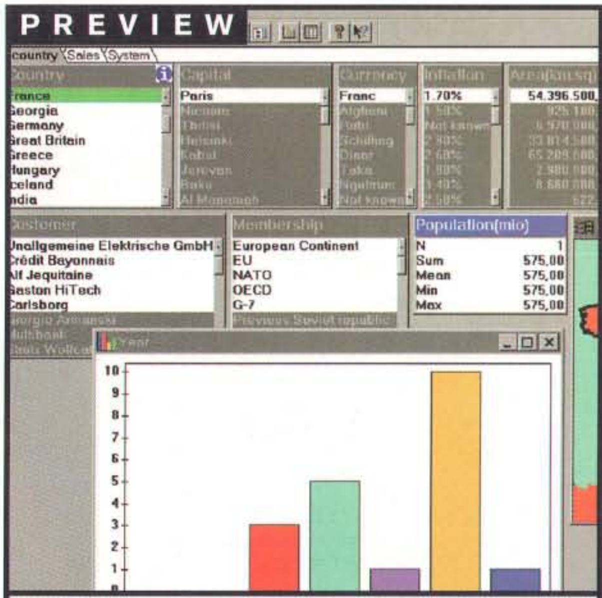
ZYIMAGE WEB SERVER FOR WINDOWS NT can help make paper and microfiche documents fully accessible on the Web without being converted into HTML. The program incorporates scanning, OCR, and text-retrieval modules.
Price: Call company.
ZyLab Europe, Amsterdam, The Netherlands, +31 20 696 6277, http://www.irt.nl.
Circle 1015 on Inquiry Card.

Programming Tools

Modeling Components

WITH FABA COMPONENTWARE, A framework for developing business management applications, programmers can create customer information systems, work-flow software, and quality-management applications out of prefabricated software modules. The process-oriented system supports OLE and lets developers incorporate standard applications.
Price: Call company.
Fallmann und Bauernfeind, Linz, Austria, +43 732 22561, coo@faba.co.at.
Circle 1016 on Inquiry Card.

PREVIEW



QlikView
Approximately DM 1100.

Circle 1005 on Inquiry Card.

QuikTech AB
Lund, Sweden
+46 46 182700
fax +46 46 182661
info@quiktech.se

New Insights into Databases

Do you ever need to browse through all your databases, link the common fields, include charts, and display the relations in all the information sources? The QlikView information retrieval system lets you do this just by clicking on field names. In addition, the program shows you all possible field combinations and the fields that are not interconnected.

For example, a database might contain statistical information about the countries in which your company has subsidiaries. Another one may incorporate the revenues of the local representatives. QlikView links both data sources via the common "country" database field. Then you just click on the name of one representative and the program automatically highlights his or her performance by revenue and the corresponding statistical information.

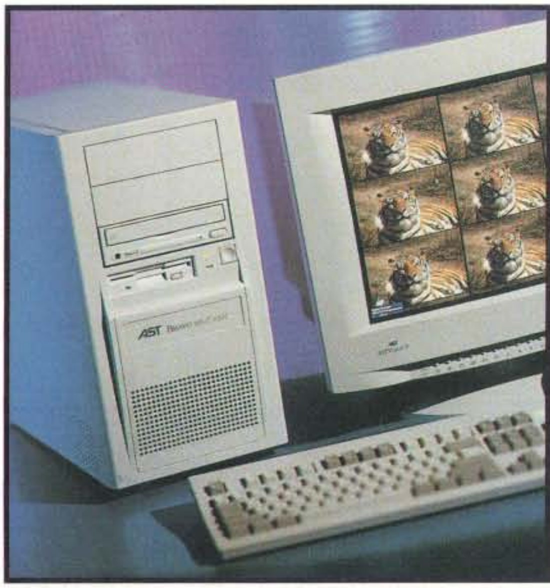
– Rainer Mauth

With a new Intel chip set, AST's Bravo MS-T 6200 is a high-end PC with a low-end price. By Selinda Chiquoine

Mainstreaming Pentium Pro

You can buy a 200-MHz Pentium Pro NT workstation now for $3000 less than you could six months ago. Take the AST Bravo MS-T 6200 we review here; it starts at $3335 with 32 MB of RAM, a 2.5-GB hard drive, and an 8x CD-ROM drive. Some of that lower cost is due to Intel's new 440FX PCI three-chip set, which effectively replaces Intel's eight-chip 450KX and GX Orion PCIsets in new single- and dual-CPU systems.

The 440FX PCIset, code-named Natoma, represents a savings in silicon and system board space—and as our testing reveals, without sacrificing performance. The Bravo's SYSmark NT score compares favorably to those of earlier systems we've tested. However, the Orion chip sets will continue to be a better fit for quad-processor designs because they support four memory controllers and two PCI bridges.



Bravo MS-T 6200
$4754
(as tested with 200-MHz Pentium Pro, 64 MB of RAM, 2.5-GB hard drive, 8x CD-ROM drive, 4 MB of WRAM graphics, and 17-inch monitor)

AST Research
Irvine, CA

(800) 876-4278
(714) 727-4141
http://www.ast.com

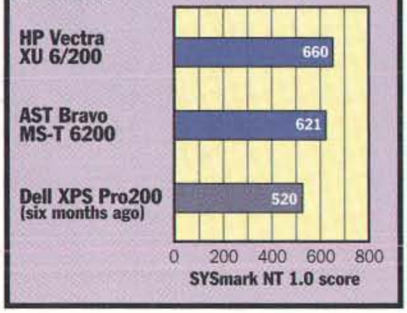
Circle 1080 on Inquiry Card.

AST's 200-MHz Bravo, ordered with parity or ECC memory, is well suited for corporate computing.

The 440FX PCIset supports up to 1 GB of extended data out (EDO) DRAM, burst EDO DRAM, or fast page-mode DRAM, and it allows concurrent PCI. It also complements the Pentium Pro's split-transaction bus, enabling more efficient use of bus cycles. The 440FX is PCI 2.1-compliant and also supports the Universal Serial Bus (USB).

NT Performance

AST's Bravo is much faster than the 200-MHz Dell we tested six months ago, thanks to improved NT graphics card drivers. HP's Orion-based Vectra (shown for comparison) is faster due to its 7200-rpm SCSI drive.



Although the Bravo MS-T 6200 supports ECC and parity memory, it comes standard with nonparity memory (64 MB of 60-ns EDO RAM in the system that we tested), which could be a reliability concern with some large-memory applications. Maximum capacity is 128 MB divided across four memory banks, in 16-MB SIMMS. A 5200-rpm 2.5-GB EIDE hard drive , 8x IDE CD-ROM drive, 2-MB Matrox MGA Millennium graphics card, and 16-bit audio with microphone are standard. Our test system came with 4 MB of Window RAM (WRAM) on the graphics card and a 17-inch AST monitor. Although there are plenty of available slots, SCSI and networking are not integrated into this system.

Software installed on the Bravo MS-T 6200 includes Windows NT; AST-CommandCenter, a group of utilities; as well as a disk-making utility, NetCom's NetCruiser, Netscape Navigator, Internet Factory's Communications Builder, and SoftQuad's HoTMetaL Light 2.0 (an HTML editor).

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★
PERFORMANCE	★★★

AST claims to distinguish itself with high-quality components and construction, aptly chosen software, excellent documentation, and a reasonable price. With some exceptions like nonparity memory and lack of built-in networking, we agree that this system is well suited for corporate computing. B

Selinda Chiquoine is a former BYTE technical editor. You can reach her at **selinda@bix.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Netscape throws everything but the kitchen sink into the new upgrade of the Web's premier browser. ***By Rex Baldazo***

Navigator Turns 3.0

We've barely had time to digest the new features (and risks) of Navigator 2.0 and—look out—here comes version 3.0. But don't panic: While you'll find new multimedia plug-ins and Java enhancements, as well as some improvements to existing features, there's nothing about Navigator 3.0 that makes it a must buy.

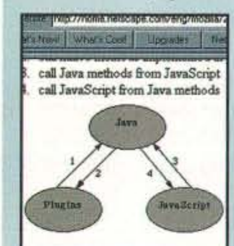
By comparison, the 1.0-to-2.0 upgrade was substantial, bringing innovations such as the now-ubiquitous Java, as well as a very good mail reader and newsreader. Version 2.0 also introduced Netscape Plug-Ins, which let developers offer unique functions that run inside a Navigator window.

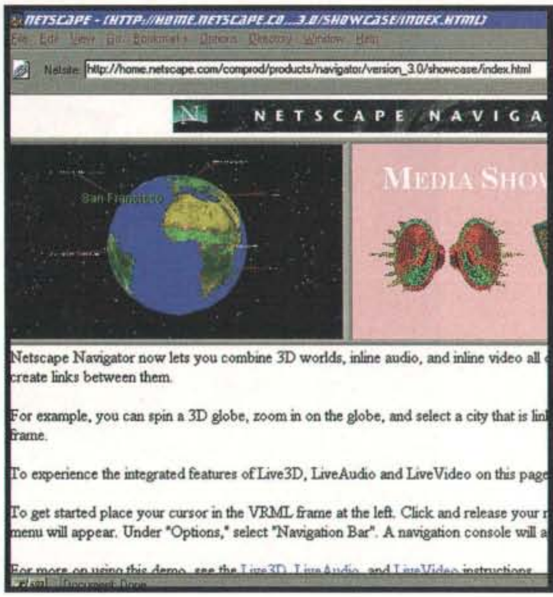
Beyond the new Plug-Ins for audio, video, and 3-D Virtual Reality Modeling Language (VRML), Navigator 3.0's biggest changes are the extensions to JavaScript, Netscape's scripting language for browsers and servers. Scripts can now detect installed Plug-Ins, and there's a built-in Array object. A new feature called LiveConnect lets your scripts interact with Java applets loaded in the browser. JavaScripts now have the ability to load images dynamically as needed, depending on specific events or user interaction.

TECH FOCUS

Where Plug-Ins Connect

Navigator's new LiveConnect feature enables Java, JavaScript, and Navigator Plug-Ins to interact. The following calls are allowed: 1) to Java methods from Plug-Ins; 2) to native methods implemented in Plug-Ins from Java; 3) to Java methods from JavaScript; and 4) to JavaScript from Java methods. JavaScript and the Navigator Plug-Ins have to communicate with each other through Java.


call Java methods from JavaScript
call JavaScript from Java methods


NETSCAPE - [HTTP://HOME.NETSCAPE.CO...3.0/SHOWCASE/INDEX.HTML]
File Edit View Go Bookmarks Options Directory Window Help
Netsite: http://home.netscape.com/comprod/products/navigator/version_3.0/showcase/index.html
NETSCAPE NAVIGA
San Francisco
MEDIA SHOW

Netscape Navigator now lets you combine 3D worlds, inline audio, and inline video all
create links between them.

For example, you can spin a 3D globe, zoom in on the globe, and select a city that is lin
frame.

To experience the integrated features of Live3D, LiveAudio and LiveVideo on this page

To get started place your cursor in the VRML frame at the left. Click and release your
menu will appear. Under "Options," select "Navigation Bar". A navigation console will a

For more on using this demo, see the Live3D, LiveAudio, and LiveVideo instructions.

Document: Done

Besides bundling new Plug-Ins for audio, video, and 3-D VRML, Navigator 3.0 retains its predecessor's occasional color glitches.

Netscape Navigator Gold 3.0
$79

Netscape Communications
Mountain View, CA

(415) 937-2555
(415) 937-3777
http://home.netscape.com

Circle 1063 on Inquiry Card.

Hypertext Markup Language (HTML) editing capabilities are also improved. Finally, the company that helped popularize HTML tables offers an editor that can handle them. Unfortunately, the process is still not close to being WYSIWYG. The text in our table was centered and in boldface when we viewed it in the edit window, but it was left-aligned and in normal face when we displayed it in the browser window.

Netscape has finally fixed the Back button so that it now works the way you expect it to in a frame environment. In Navigator 2.0, clicking on the Back button would take you off the current frameset entirely. With 3.0, it navigates you back through the just-viewed frames.

Netscape still knows how to produce interesting bugs. Unlike the infamous invisible/Greek font problems in Navigator 2.0, the bugs introduced in 3.0 seem likely to be fixed in the final version. They'd better be: The one we encountered most often was a crash under Windows NT 4.0. It occurred whenever we tried to view Netscape's Media Showcase, which highlights the multimedia capabilities of 3.0's Plug-Ins.

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★

All this is a lot to consider when deciding whether to switch from 2.0. We'll move to 3.0 because the Back button finally works the way it should. **B**

Rex Baldazo is BYTE's technical editor for software reviews. You can reach him at **rbaldazo@bix.com**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Introducing the first PC worthy enough to work beside your trusty HP printer.
HP PCs
HP Vectra 500 PC

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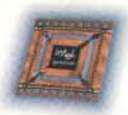

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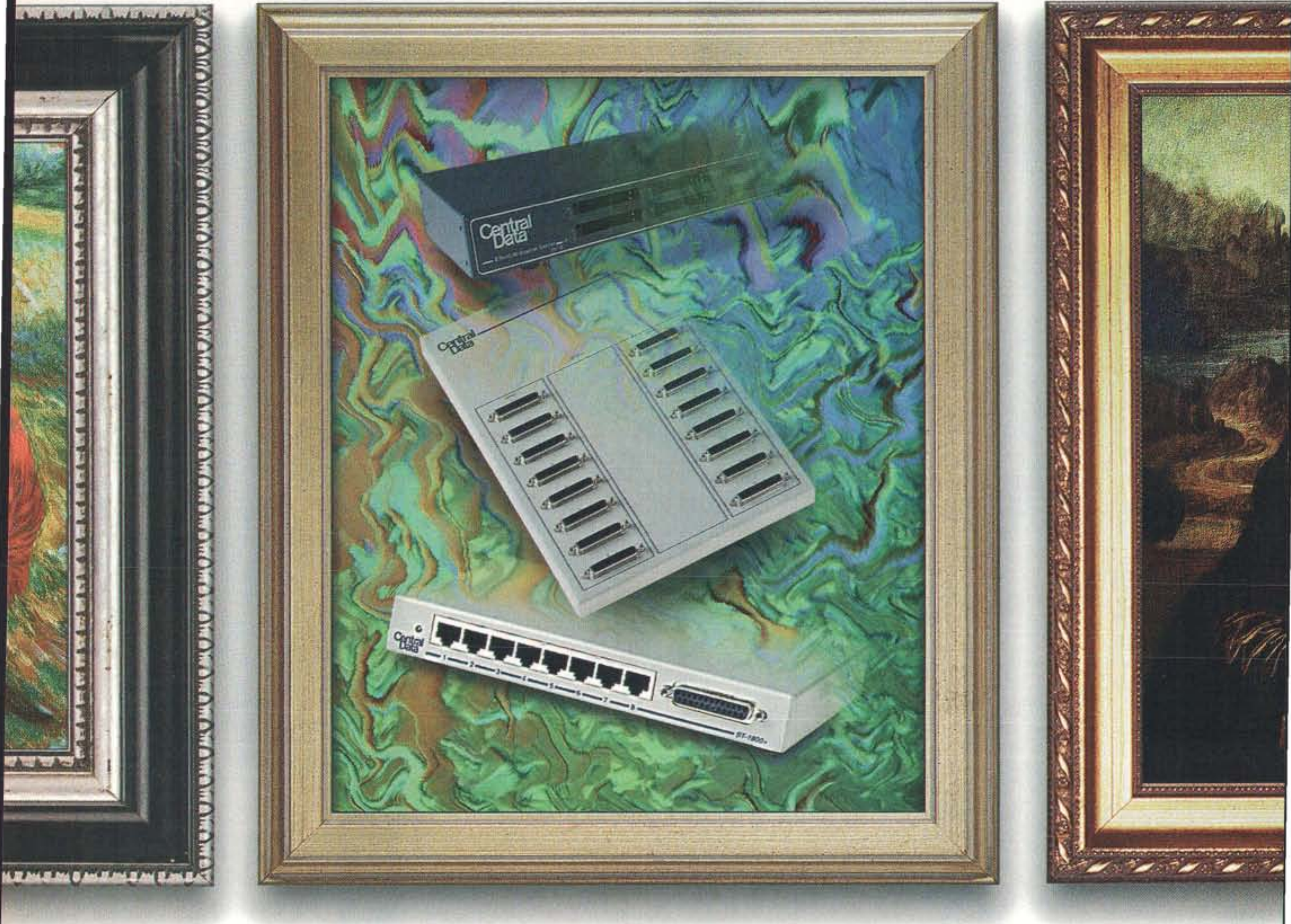

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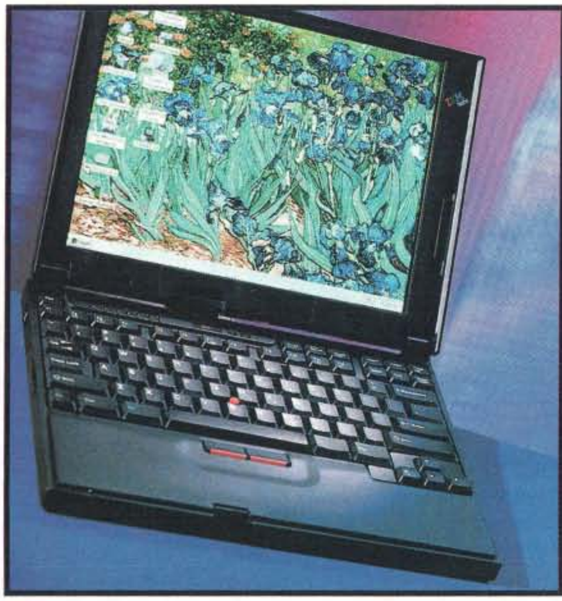
IBM's new ThinkPad 560 packs a lot of features and power into its sleek frame—but not without compromise. By Dave Andrews

ThinkPad Proves You Can Be Too Thin

IBM's thin new ThinkPad 560 packs a ton of features into its 4.1-pound package, but not enough to match those of standard notebooks. While this affordable machine doesn't address everyone's portable-computing needs, it will be very attractive to mobile workers who want to combine portability with an easy-typing keyboard and a big, bright screen.

The ThinkPad 560's 12.1-inch active-matrix screen and expansive keyboard will make you forget many of the horrors that subnotebooks inflicted upon us two years ago. The system also has an 810-MB standard hard drive (1.08 GB is an option), a choice of 100-, 120- or 133-MHz Pentium CPU, and memory expandability up to 40 MB. On the other hand, the floppy drive is external, and there's not yet a way to fit a CD-ROM drive into a notebook that measures only 1.2 inches thick.



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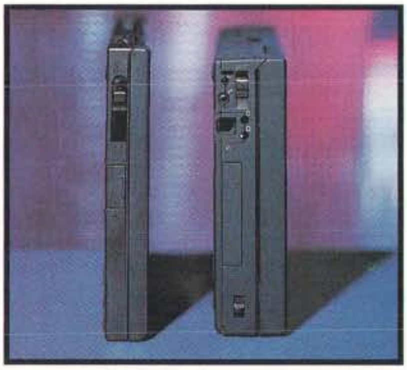
The ThinkPad 560's 12.1-inch active-matrix screen and expansive keyboard will make you forget the horrors of subnotebooks past.

The ThinkPad 560's delightful 800- by 600-pixel screen gives you about the same viewing real estate as a 14-inch desktop monitor (you can also get a less expensive 100-MHz configuration with an 11.3-inch passive-matrix screen). The screen is such a dominating component in the new thin form factor that IBM had to use an especially rigid hinge with a stiff action to keep the screen propped open. The company also put the heavier elements of the 4.1-pound notebook, such as the hard drive and lithium battery pack, near the front to counter the weight of the display and to keep the notebook from toppling over while in operation.



The thin ThinkPad 560 and the thick ThinkPad 760CD.

PHOTOGRAPH: LIGHTWORKS PHOTOGRAPHIC, INC.© 1996

Another big benefit is the unit's full-size keyboard (11 inches from the Caps Lock to the Enter key). We found it easy to type on, compared to the cramped layouts of subnotebooks of past years.

IBM has eliminated many of the compromises associated with small notebooks, but not all. The most noticeable lack is internal drive options. There's no internal CD-ROM or floppy drive. If you need to get data off a floppy disk, you have to use an included external 1.44-inch drive that cables to a special port. (At least you don't have to turn off the unit when you attach the external floppy drive.) For reading CD-ROMs, you have to invest in a third-party device. Furthermore, IBM's resurrected subnotebook lacks an integrated modem.

Nor does the ThinkPad 560 deliver other multimedia extras, such as a video-in port or built-in stereo speakers. For video-in, you have to use a PC Card solution (the 560 has two Type II PC Card slots). The system's tinny speaker is underneath the keyboard and offers only a modicum of multimedia support.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★

Still, this ThinkPad goes just about anywhere that paper goes. And it doesn't weigh a whole lot more. B

Dave Andrews is a BYTE news editor. You can reach him at **dave.news@bix.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Eval

Power Mac Clone

Power Computing's 180-MHz Mac clone reveals the power of RISC. By Tom Thompson

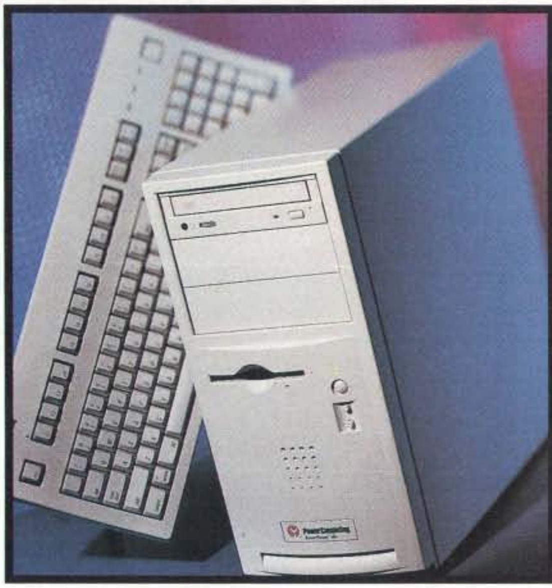
Move Aside, Mac

As the first Mac OS licensee, Power Computing must stay nimble to grab market share. So far, so good. As Apple ships its 150-MHz Power Mac 9500, Power Computing counters with its 180-MHz Mac-compatible PowerTower.

A standard PowerTower 180 includes a 180-MHz PowerPC 604 RISC processor, 512 KB of L2 cache memory, 32 MB of RAM, a 2-GB SCSI hard drive, a built-in video subsystem with 2 MB of video memory, and two Ethernet connectors (10Base-T and Apple's attachment unit interface [AUI])—enough to satisfy the most demanding power user. The price isn't bad either: $4195 as reviewed. The PowerTower's mini-tower chassis provides three 5¼-inch storage bays (a standard quad-speed CD-ROM drive occupies one bay) and three PCI expansion slots.

The PowerTower 180 employs Apple Power Mac 7200 ASICs, which provide only a 64-bit data path, while the Power Mac 9500 ASICs have a 128-bit data path with memory interleaving. Power Computing chose the 7200 ASICs because they can operate at 60 MHz (a good 3× match for a 180-MHz CPU), while the 9500 ASICs top out at 50 MHz.

The PowerTower 180 arrived with Apple's System 7.5.3 and a generous selection of software, including ClarisWorks 4.0, Now Utilities 6.0, Intuit's Quicken SE, and other applications. (We disabled the bundled Connectix Speed Doubler software accelerator to properly assess system throughput.) Several weeks of heavy use with a wide assortment of Mac software proved the system's Mac compatibility.



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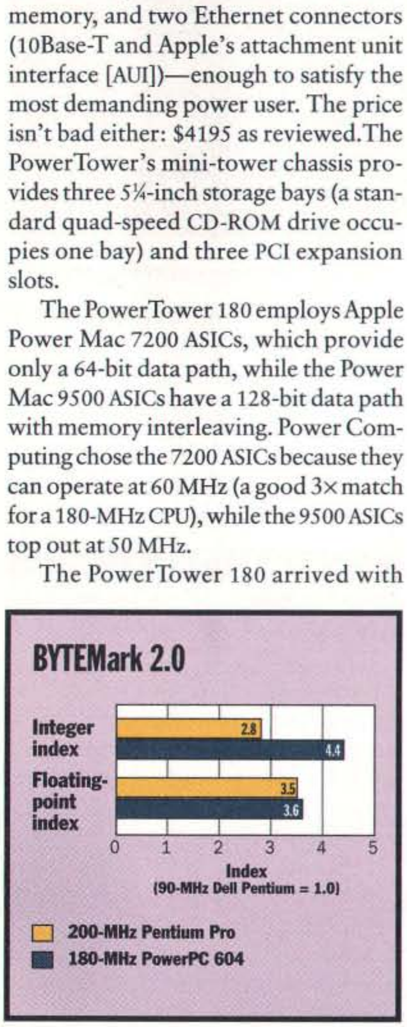
Fast file and image manipulation make the PowerTower 180 a multimedia author's dream machine.



Running Mac software at 180 MHz is intoxicating. Multitasking Claris's MacWrite Pro and Netscape's 2.0 browser while downloading files with Aladdin's SITcomm telecommunications program proved quick and smooth. We had no network problems using TCP/IP applications through either a corporate DHCP server connection or by a dial-up connection using FreePPP 2.5.

Editing complicated 3-D graphics in Adobe Dimensions 2.0 was effortless, and operations in Adobe Photoshop 3.0.4 simply flew. Where a Power Mac 9500/132 might slow to a crawl managing file-filled folders, the PowerTower ran the Mac File Manager's emulated 680x0 code effortlessly.

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★★

Even though the PowerPC 604 trails a 200-MHz Pentium Pro by 20 MHz, it posted far better integer performance and similar floating-point performance. Its combined file- and image-manipulation capabilities make the PowerTower a multimedia author's dream machine. ■

Tom Thompson is a BYTE senior technical editor at large and author of The PowerPC Programming Kit *(Hayden Books, 1996). You can reach him at* **tom_thompson@bix.com.**

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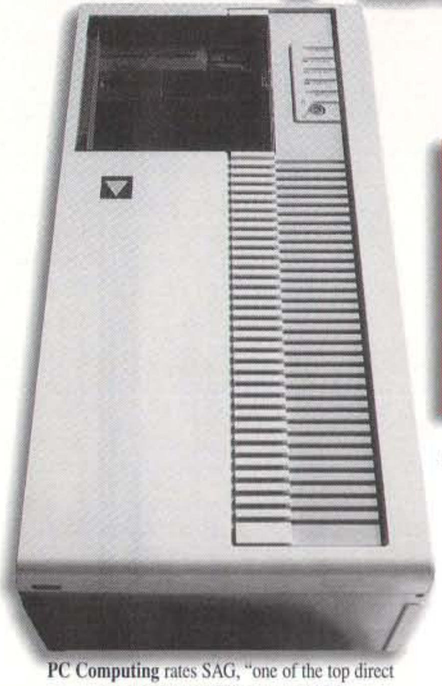

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Windows NT offers industrial-strength security features. ***By Jim Reynolds***

Air-Tight Windows NT

Windows NT offers features that meet the practical security requirements of businesses. For everyday users, NT restricts who uses the computer and controls what each authorized user does. For administrators, NT provides tracking and auditing capabilities, enabling network managers to monitor who attempts to use a particular computer and what each user attempts to do.

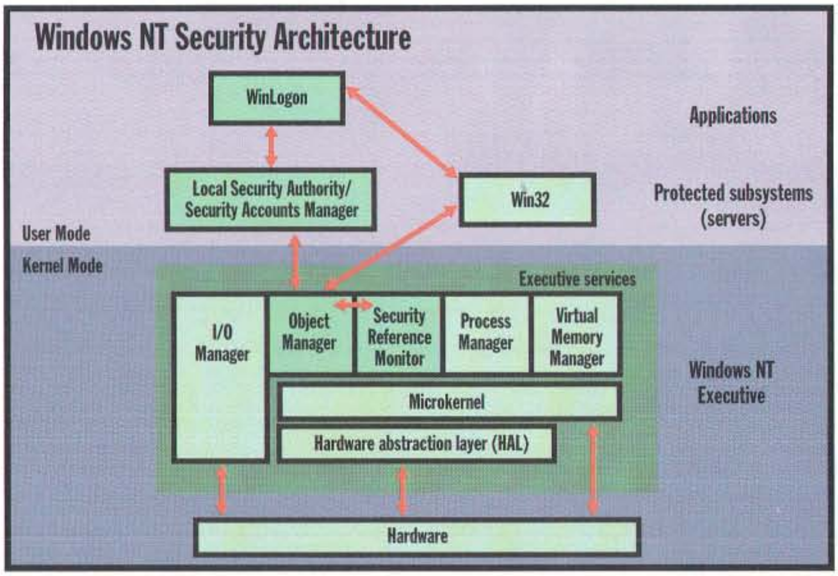
These security features match very closely with the requirements described in the Department of Defense's "Orange Book" for the C2-level of security "assurance" for commercial computer products. Microsoft decided very early in NT's development to achieve C2-level security status for the OS, to meet the requirements of certain Defense markets.

Security Architecture

Microsoft engineers designed Windows NT to be a portable OS with minimal dependence on a processor's unique hardware features. However, all NT implementations rely on the processor to provide two execution modes: kernel and user. Kernel mode, as its name implies, is used by the privileged OS code, including the kernel, to protect system data. Code running in this mode communicates directly with the hardware. Code executing in user mode must use OS calls to modify system data and access the hardware.

Windows NT consists of an executive and several protected subsystems (also called servers). The executive lies atop the hardware abstraction layer (HAL) and operates in the kernel mode. Above the executive lie the subsystems that interact with users and execute in user mode. User processes execute only in user mode and must make requests to the subsystems in order to obtain access to the computer's facilities.

The security components of NT consist of two parts that execute in user mode: WinLogon and a protected server called the Local Security Authority (LSA). The LSA relies on the Security Accounts Manager (SAM) and two executive components, the Object Manager and the Security Reference Monitor (SRM), to determine access privileges and obtain system resources (see the figure "Windows NT Security Architecture").


Windows NT Security Architecture
WinLogon
Applications
Local Security Authority/ Security Accounts Manager
Win32
Protected subsystems (servers)
User Mode
Kernel Mode
Executive services
I/O Manager
Object Manager
Security Reference Monitor
Process Manager
Virtual Memory Manager
Windows NT Executive
Microkernel
Hardware abstraction layer (HAL)
Hardware

The Object Manager and the Security Reference Monitor protect system resources.

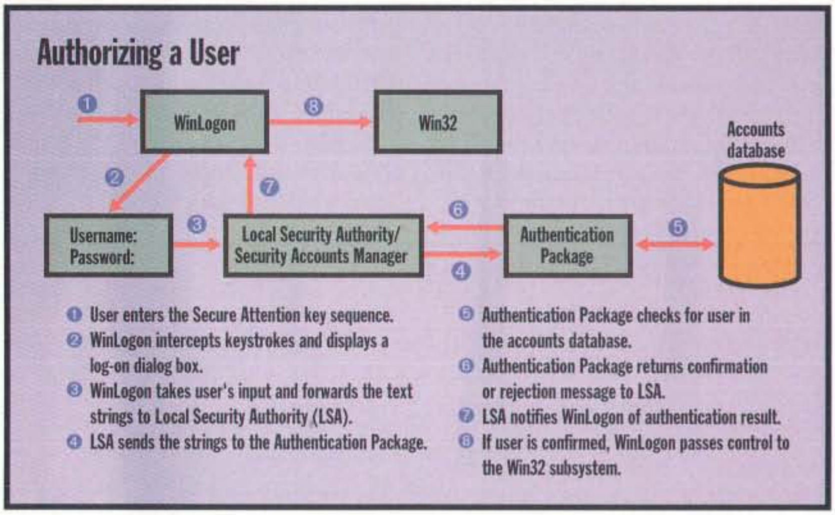
Although NT is not object-oriented in the broadest sense, it treats all of a computer's resources as objects, and access to all objects is handled by the Object Manager. Files, memory, processes, and more specialized resources like semaphores and I/O completion ports are all objects. This uniform approach simplifies the implementation of security features and provides greater assurance that they work properly. The Win32 environment subsystem must ask the Object Manager on behalf of a user to create, open, close, delete, or perform whatever operation is appropriate to the particular type of object.

NT associates a security ID with every user, and every object has an access control list (which may be empty) that specifies which users or groups of users are allowed to work with the object. Before NT performs any operation, the Object Manager checks with the SRM to determine if the user has the permissions or rights required to perform the operation on the object.

Authentication

Identification and authentication are the most fundamental security features of an OS. To log onto NT, you press a familiar key combination: Ctrl-Alt-Del. This actually implements a feature—called Trusted Path—required by the Orange Book. This requirement assures the user that if she presses the so-called Secure Attention Sequence first, the resulting prompt for username and password is from the OS and not from some spoofing program written by a malicious user. The user must identify herself with a username and authenticate herself, typically with a password. NT is sufficiently modular that a more sophisticated authentication mechanism can be implemented; for example, the administrator could substitute a retinal scanner. (See "Authorizing a User" for a summary of the log-on sequence.)

Every user belongs to one or more groups, and a few special groups are built in. Each group has a name and a set of user rights. Users have the rights of all the groups they belong to, plus any special rights granted to that particular individual. These rights are assigned collectively when the administrator makes a user a member of a defined group.



① User enters the Secure Attention key sequence.

② WinLogon intercepts keystrokes and displays a log-on dialog box.

③ WinLogon takes user's input and forwards the text strings to Local Security Authority (LSA).

④ LSA sends the strings to the Authentication Package.

⑤ Authentication Package checks for user in the accounts database.

⑥ Authentication Package returns confirmation or rejection message to LSA.

⑦ LSA notifies WinLogon of authentication result.

⑧ If user is confirmed, WinLogon passes control to the Win32 subsystem.

NT's log-on process prevents an unauthorized user from entering the system.

There are roughly two dozen user rights, including the ability to define printers, add hardware (such as Ethernet cards) to the system, and shut down the computer. Each user acquires a set of rights, either from the groups she belongs to or by the administrator specifically granting them.

Auditing for Attacks

Because no system is absolutely secure, administrators need to be able to determine if their system has been the target of an attack, or has been vulnerable to the misadventures of a nonmalicious user. In the case of NT, auditing policy is set and controlled with the User Manager.

The User Manager provides an easy interface to specify the level of auditing. Because the auditing process contributes to system overhead, the amount of audit information to be captured has to be carefully weighed in consideration to overall system requirements. NT divides audited user actions into seven categories, including file and object access, logging on and off, and exercise of user rights. Actions within each category can be audited for success, failure, or both. For example, you may not want NT to produce an audit record every time a user logs on, but you'd want to record unsuccessful attempts to log on. Similarly, you'd probably record unsuccessful attempts to access files or directories—such activities indicate malicious snooping.

You use the Event Viewer to examine audit records. It allows examination of three different logs: system events, application events, and security events. Each event record is time-stamped, and both the process and the user attempting the operation are identified. A log is an object just like every other resource controlled by NT, and therefore it has an access control list associated with it. By default, only members of the Administrators group can examine the security log. With the Event Viewer, an authorized user can control important aspects of the logs. Particularly important from a security point of view and required for C2-level rating is the ability to guarantee that no security event records can be lost. Logs, naturally, are limited to a certain length, and by default are overwritten when full. In special situations, the administrator can prevent overwriting the log by forcing a system shutdown when the log is full.

Object Reuse

Underlying all of NT's logical objects are physical RAM and disk space, both of which are continually being recycled for new processes and files. Object reuse is a security requirement that prevents a user from accessing the remains of another user's work, particularly when the OS creates new objects from previously used resources.

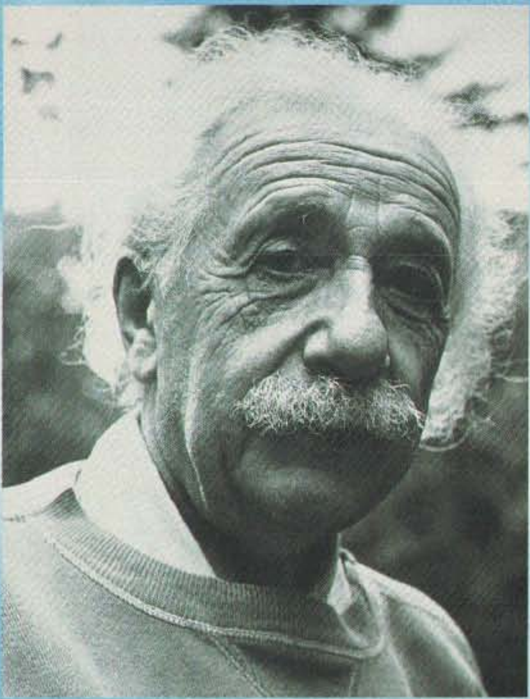
Long-time DOS users are well aware that "erasing" a disk file doesn't clear the file's contents from the hard disk: It simply marks the region on the disk as unused. Other users can examine this region's contents, provided another process hasn't already written over the same area of the disk. Secure systems require that such a scenario isn't possible. When NT creates a new object (either memory or file) for a user, it is empty of data. That is, the OS clears the object of its previous data or assigns it a zero-length size.

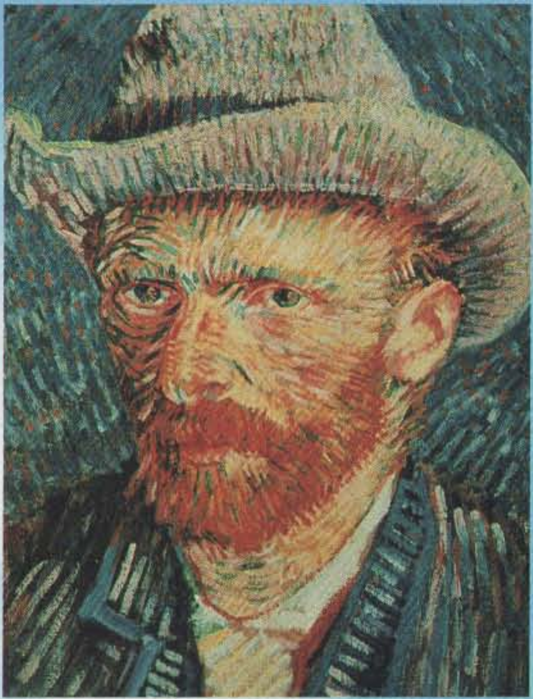
For file objects, NT prohibits you from reading past a file's logical end-of-file marker and thus possibly peeking at data from an erased file. Also, if you have the right to extend the file, NT overwrites that area on disk before granting access to it.

When a program allocates memory, NT first clears the section of RAM that a newly created memory object will occupy. This prevents a user from probing random locations in RAM, searching for the vestiges of documents or file buffers that might contain confidential information. Of course, because of NT's security mechanisms, processes can access only blocks of memory granted to them.

NT is a reasonably secure general-purpose OS. As an indication of this, in August 1995, the National Security Agency granted Windows NT 3.5 C2-level approval. Its security features make it comparable to Digital Equipment's VMS and superior to Unix. NT provides a unique combination of security and convenience that is long overdue in the personal computer world. **B**

Jim Reynolds was a member of the National Security Agency's Windows NT evaluation team. He also participated in the evaluation of three other commercial OS products for the "Orange Book" program. You can reach him at **reynolds@mitre.org**.





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A new revision to this management protocol addresses performance issues and corrects some flaws. ***By William Stallings***

Patching the Cracks in SNMP

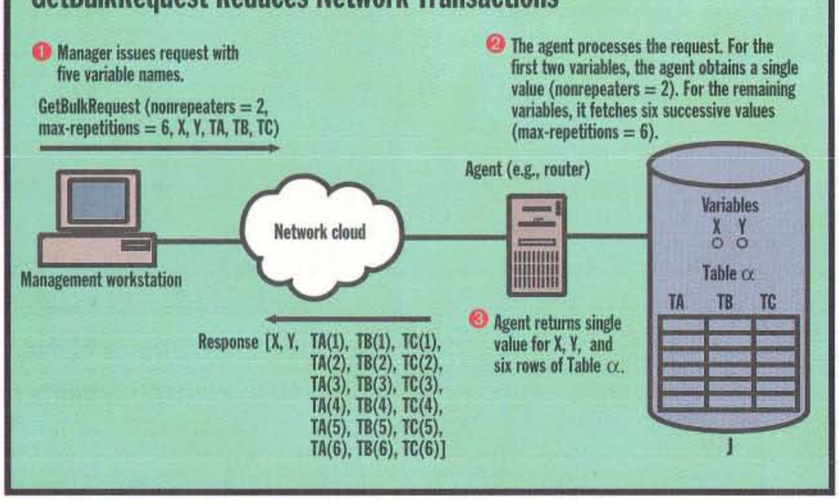
In 1988, the Internet Engineering Steering Group (IESG) released the first version of the SNMP specification. Its goal was grand yet practical: to provide an easily implemented, low-overhead foundation for multivendor network management of routers, servers, and other network resources. As a public standard, the original version of SNMP (now known as SNMPv1) rapidly became the most widely used vendor-independent network management scheme.

As SNMPv1 gained widespread use, some deficiencies became apparent. These included a lack of manager-to-manager communication, the inability to do bulk data transfer, and a lack of security. The IESG sought to remedy them by revising the specification. In 1993, it issued version 2 (known as SNMPv2) as a set of proposed Internet standards. However, it has not received widespread acceptance. That's because while the functional enhancements have been welcome, developers found the security facility for SNMPv2 too complex.

The IESG worked on an enhancement to SNMPv2. It completed the task in January and announced the revised standard as SNMPv2c. This version employs the SNMPv1 message wrapper, with its use of the community concept, which has a simple password-based security model. This "administrative framework" for SNMPv2 is termed community-based SNMPv2, which explains the *c* suffix.

The results of this effort have been one minor success and one major failure. The minor success is the tune-up of the functional aspects of SNMPv2. The major failure is in the area of security. SNMPv2c's password-based approach to security is anything but secure. The IESG was unable to resolve the issue, and two competing approaches emerged.

The first approach is User-Based Security Model for SNMP, or SNMPv2u. SNMPv2u takes a minimalist approach to providing security and is centered on capabilities provided by the agent. (An agent is a software package running on any system that is to be managed, such as PCs, workstations, bridges, routers, servers, and hosts.) SNMPv2u provides the basic elements for network management security, namely, the ability to authenticate managers and provision for confidentiality of exchanged messages. (A manager or management system is a desktop computer running management software and operated by a user.)


GetBulkRequest Reduces Network Transactions

❶ Manager issues request with five variable names.
GetBulkRequest (nonrepeaters = 2, max-repetitions = 6, X, Y, TA, TB, TC)
❷ The agent processes the request. For the first two variables, the agent obtains a single value (nonrepeaters = 2). For the remaining variables, it fetches six successive values (max-repetitions = 6).
Agent (e.g., router)
Network cloud
Management workstation
Variables
X Y
Table α
TA TB TC
❸ Agent returns single value for X, Y, and six rows of Table α.
Response [X, Y, TA(1), TB(1), TC(1), TA(2), TB(2), TC(2), TA(3), TB(3), TC(3), TA(4), TB(4), TC(4), TA(5), TB(5), TC(5), TA(6), TB(6), TC(6)]

This new SNMPv2c command lets a network management program obtain information from a remote agent with only one transaction.

The second approach is SNMPv2*. This more ambitious approach adds to SNMPv2u features implemented at the management station and deals with issues of remote configuration not addressed in SNMPv2u. SNMP is able to remotely configure an agent to include new Management Information Base (MIB) objects.

Because of this schism, the IESG will revisit the SNMP security matter. For this reason, we will instead look into the performance areas that the standard fixes.

Data Transfer Enhancements

SNMPv1 can generate considerable traffic when managers communicate with agents. That's because a single SNMPv1 transaction can exchange only a limited amount of data, forcing management workstations and agents to often generate multiple transactions. The result is a heavy load on the network.

To help streamline these exchanges, SNMPv2 adds a new command, `GetBulkRequest`. `GetBulkRequest` targets the one area of information exchange capable of generating the most traffic: retrieval of tables. A table represents a related set of information about a resource (e.g., a router) or activity (the traffic over a TCP connection). It is organized as a collection of rows of variables, with each row having the same sequence of variables.

With SNMPv1, you could retrieve information from such a table only one row at a time. If a manager had to see an entire routing table, he or she needed a tedious series of get/response transactions, one for each row.

Using `GetBulkRequest`, a manager can retrieve the entire table with one transaction and even retrieve additional nontable information in that same transaction. Suppose a manager wants to retrieve a router's entire routing table plus the variable `sysUpTime`, so that it could associate a system time with the retrieved table. The manager issues a `GetBulkRequest` command that lists the variable `sysUpTime`, plus the variables that correspond to each of the fields in the table.

`GetBulkRequest` also includes two parameters. The `nonrepeaters` parameter indicates how many of the listed variables are to return just one value. In our example, there is only one such variable, `sysUpTime`, so `nonrepeaters` is set to 1. The `max-repetitions` parameter indicates how many rows of the table are to be retrieved. If the manager knows the number of rows in the table, `max-repetitions` is set to that value. Otherwise, the manager makes an educated guess and, if necessary, issues additional `GetBulkRequest` commands to get additional rows. (See the figure "GetBulkRequest Reduces Network Transactions" for more information.)

Another feature of SNMPv2 that improves the efficiency of data transfer is the nonatomic `Get` command. Management stations in both SNMP and SNMPv2 use `Get` to obtain the value of one or more variables. In SNMPv1, if a `Get` command lists multiple variables, and if the agent can't return a value for even one of those variables, the entire command is rejected. SNMPv2c's nonatomic `Get` command allows partial results to be returned (hence the term *nonatomic*). This lets the agent return those values that it can and ignore the rest of the command. Again, this improves efficiency by reducing the number of exchanges across the network.

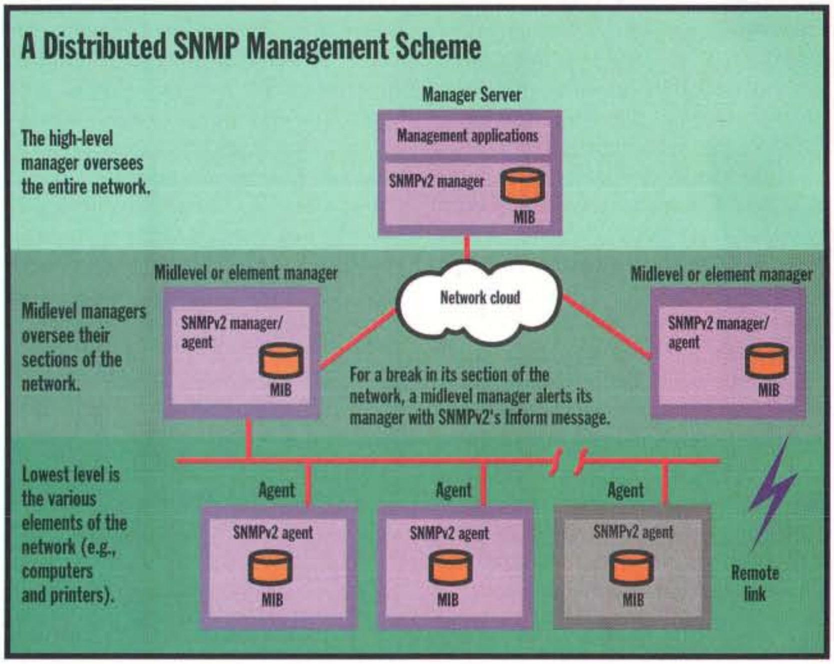
Cooperation Among Managers

Another major concern users had with SNMPv1 was the difficulty in providing manager-to-manager cooperation. The only reliable way to send information between managers was through vendor-specific mechanisms. This isn't a practical solution for networks made up of a mix of machines from different vendors. As the number of end-user systems and networks in an enterprise network configuration grows, it becomes impractical to manage the system from one network management station. Many users would like to see a decentralized management strategy, in which there may be one or a few top-level manager stations, each controlling a number of lower-level manager stations that are responsible for their portion of the network.

To support manager-to-manager cooperation, SNMPv2 introduces an `Inform` command. A manager uses `Inform` to send unsolicited information to another manager. For example, through `Inform`, a manager notifies another manager when an unusual event occurs, like the loss of a physical link or an excessive rate of traffic at some point in the network. Such unsolicited notifications provide an ideal tool for configuring a decentralized network management scheme.

Higher-level managers need not concern themselves with the details of remote parts of the network until a local event that requires central attention occurs. For example, the local manager can use `Inform` to alert the central manager that a part of its subnet has disappeared. This ability for one manager to alert another is lacking in SNMPv1.

"A Distributed SNMP Management Scheme" illustrates one kind of network configuration possible with SNMPv2.


A Distributed SNMP Management Scheme
Manager Server
The high-level manager oversees the entire network.
Management applications
SNMPv2 manager
MIB
Midlevel or element manager
Network cloud
Midlevel or element manager
Midlevel managers oversee their sections of the network.
SNMPv2 manager/agent
MIB
For a break in its section of the network, a midlevel manager alerts its manager with SNMPv2's Inform message.
SNMPv2 manager/agent
MIB
Lowest level is the various elements of the network (e.g., computers and printers).
Agent
SNMPv2 agent
MIB
Agent
SNMPv2 agent
MIB
Agent
SNMPv2 agent
MIB
Remote link

By use of a new Inform command, SNMPv2c lets a local manager notify a central manager of important network changes.

SNMP's Future

When and whether the security portion of SNMPv2 gets resolved is anyone's guess. As mentioned earlier, the IESG will revisit the issue. Because the project will start at the requirements level, it's a chance to begin with a clean slate and resolve the security issue once and for all.

Meanwhile, the functional enhancements provided in SNMPv2c should attract wide support. The technology is stable, and the cost of implementation is low for those who have implemented network resources using SNMPv1. We can expect to see a wide array of offerings from software and equipment vendors. For example, IBM announced a version of SystemView, its AIX network management software, that is compliant with the new protocol and supports the SNMPv2u security mechanism. **B**

William Stallings is a consultant and a frequent contributor to BYTE. Recent books include SNMP, SNMPv2, and RMON, *2nd ed. (Addison-Wesley, 1996) and* Local and Metropolitan Area Networks, *5th ed. (Prentice-Hall, 1996). He can be reached at* **ws@shore.net.**

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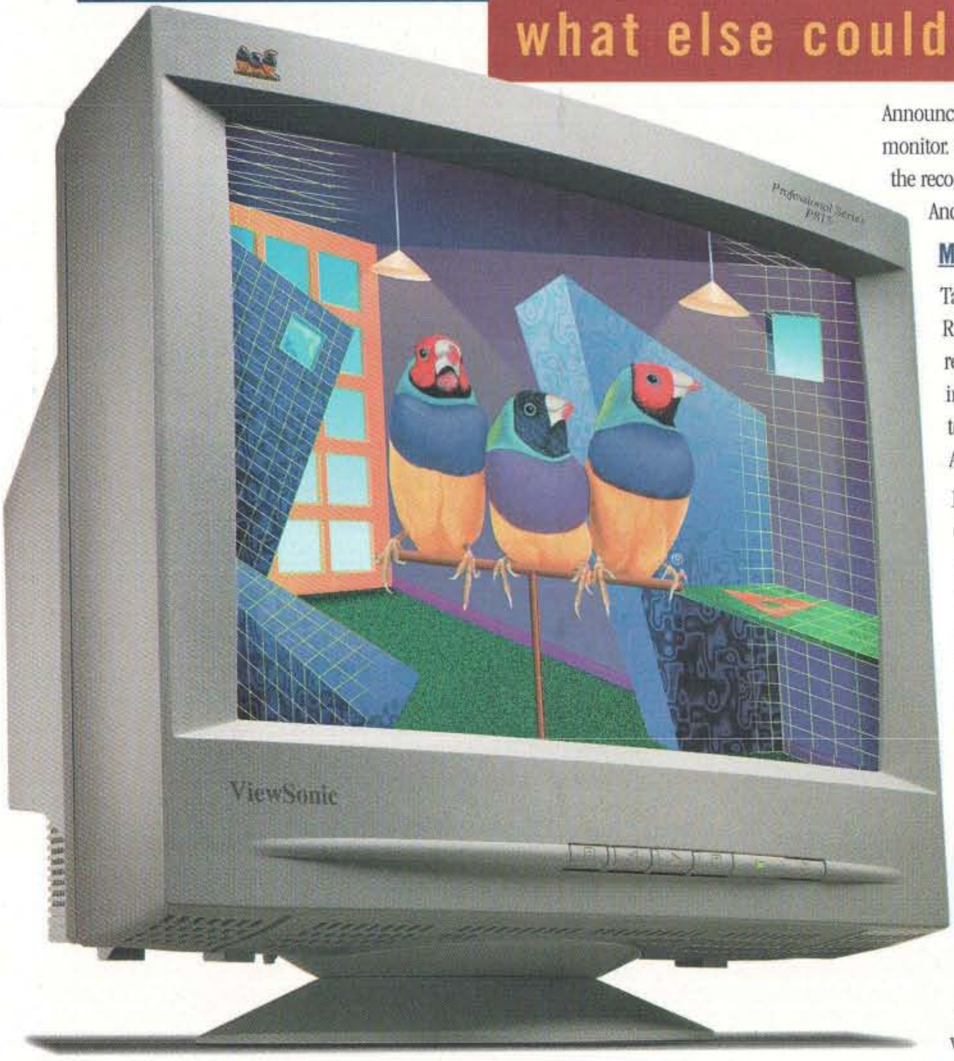

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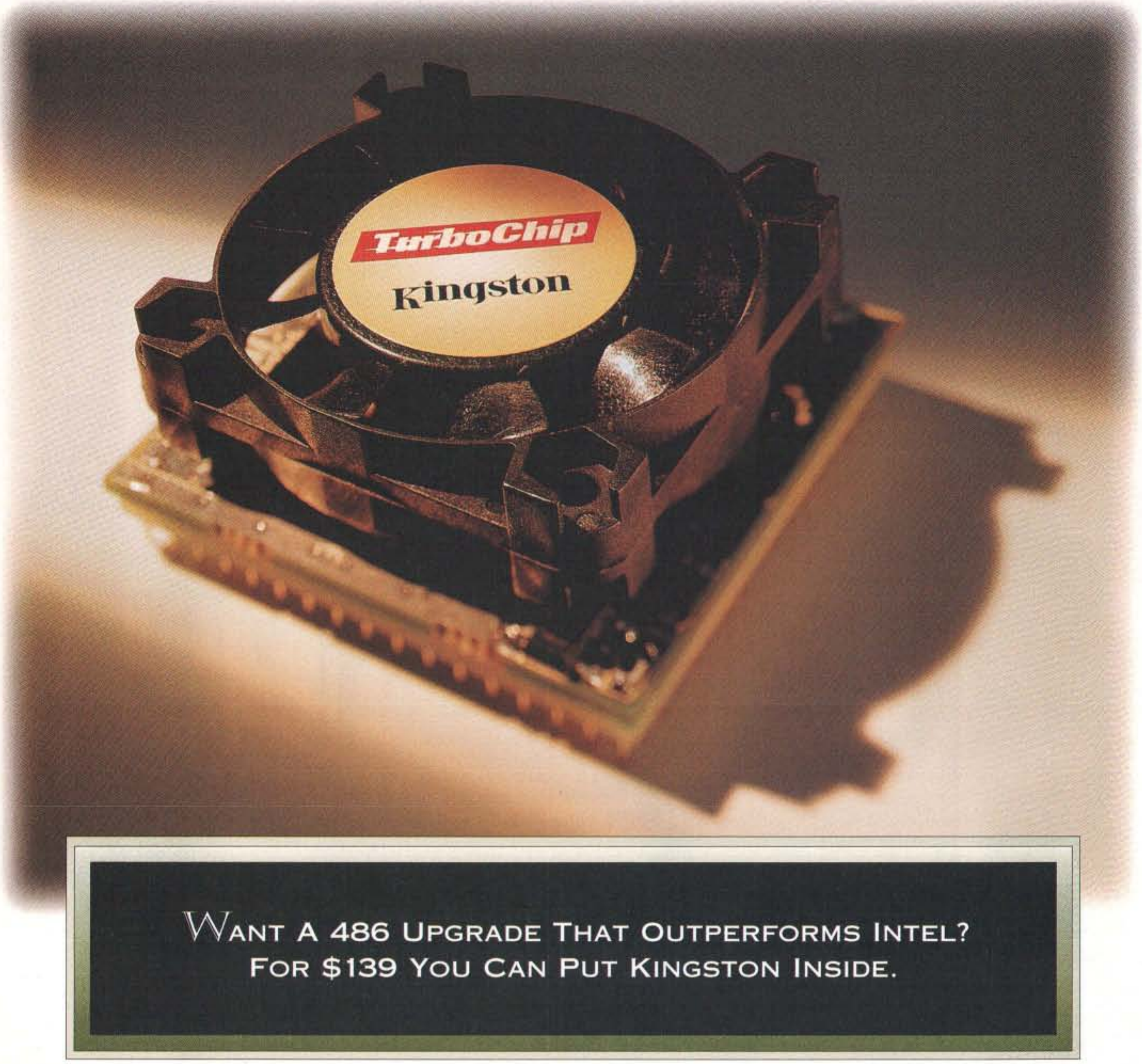

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A variant of this RISC processor targets the embedded-applications market. By Tom Thompson

The PowerPC Goes Consumer

Ask someone where you would most likely find a PowerPC RISC processor, and the reply would probably be, "a desktop computer." This is a valid answer, since most of the PowerPC's visibility comes from high-speed desktop systems, such as Apple's Power Macs and Power Computing's Mac clones.

But you can also find the PowerPC working as an embedded processor in laser printers or network adapter cards. The PowerPC's use in embedded systems shouldn't come as a surprise. This RISC processor's throughput is ideally suited for the computing demands of today's 32-bit computer peripherals.

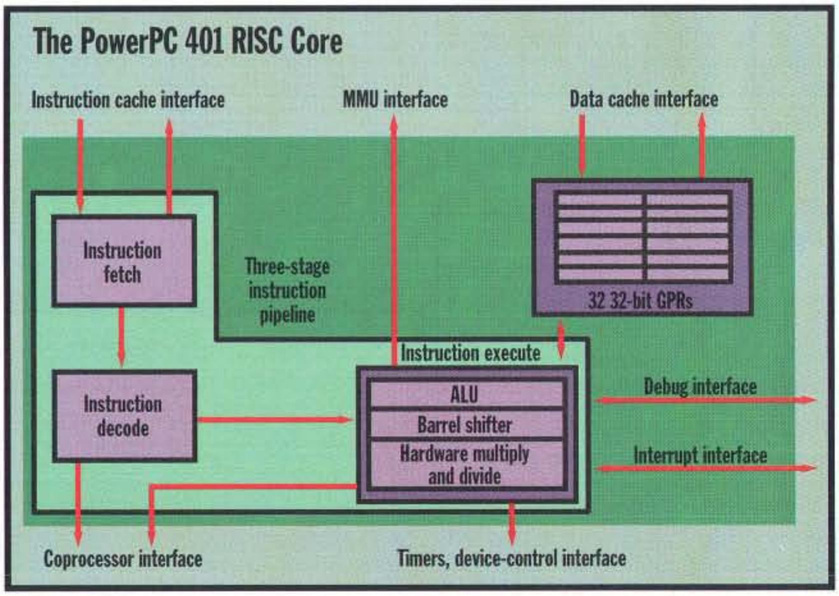
The PowerPC's foray into the embedded market isn't new. IBM introduced the PowerPC 403, a microcontroller version of the processor, in April 1994. One of the latest variants of this design, the 403GB, features a PowerPC core that dispatches two instructions at a time. However, its very sophistication, combined with the physical footprint required to support separate address and data buses, makes the 403 a poor fit for cost-sensitive consumer electronics or hand-held devices.

Enter the PowerPC 401GF. While it retains many high-performance features of its predecessor, it does so with a slimmed-down RISC core. A multiplexed bus interface reduces the chip's footprint; in addition, at 2.5 V, it consumes only 40 milliwatts at 25 MHz. This makes the 401 ideal for custom embedded-processor applications in the low-cost consumer-electronics market.

The Small yet Smart Core

The 401GF gets both its smarts and its processing brawn from a 32-bit RISC processor core that's code-compliant with the PowerPC 60x family. Called the 401 core, it sports a surprising number of 60x processor features, as shown in the figure "The PowerPC 401 RISC Core" below.

It has 32 32-bit general-purpose registers (GPRs), several special-purpose registers (SPRs), an ALU, multiply and divide hardware for 32-bit integers, a barrel shifter, and control logic that supervises data flow and code execution in the core. The 401GF also has static-branch-prediction logic, similar to that used by the PowerPC 601 and 603, to improve code performance.


The PowerPC 401 RISC Core

The 401 core has a three-stage pipeline.

The 401 core has a three-stage pipeline (instruction fetch, instruction decode, and instruction execute) that boosts code throughput. These pipeline stages also expose some of the decoded instructions for use by other function units, such as the 401GF's memory management unit (MMU).

But certain design compromises were made to reduce the 401 core's transistor count, thereby reducing its power consumption. For example, the 401 core does not have an FPU.

Moreover, while the 60x family has multiple execution units that can operate on two or more instructions concurrently, the 401 core executes a single instruction at a time. While this trade-off constrains the 401 core's performance, it also eliminates the large number of transistors required for buffers, reservation stations, and other logic needed to support the concurrent operation of the execution units.

The end result is a RISC core that is comprised of only 85,000 transistors and is physically very small. Using 0.5-micron, triple-level-metal CMOS fabrication technology, the 401 core occupies only 4.5 square millimeters on a die.

IBM also offers custom solutions, in which the 401 core and optional function units can be fabricated into an ASIC that is targeted for a specific design. The 401GF represents such an implementation, with its data and instruction caches, MMU, several timers, and peripheral interface.

Embedded Power

The heart of the 401GF consists of three tightly coupled function units: the 401 CPU core, the data-cache unit (DCU), and the instruction-cache unit (ICU), as shown in the figure "The PowerPC 401GF Architecture" at right. The 401 core, in tandem with the bus-interface logic, can field misaligned data on load/store instructions. This capability allows programmers to tightly pack data or code and conserve RAM, which is a high-cost item for embedded applications.

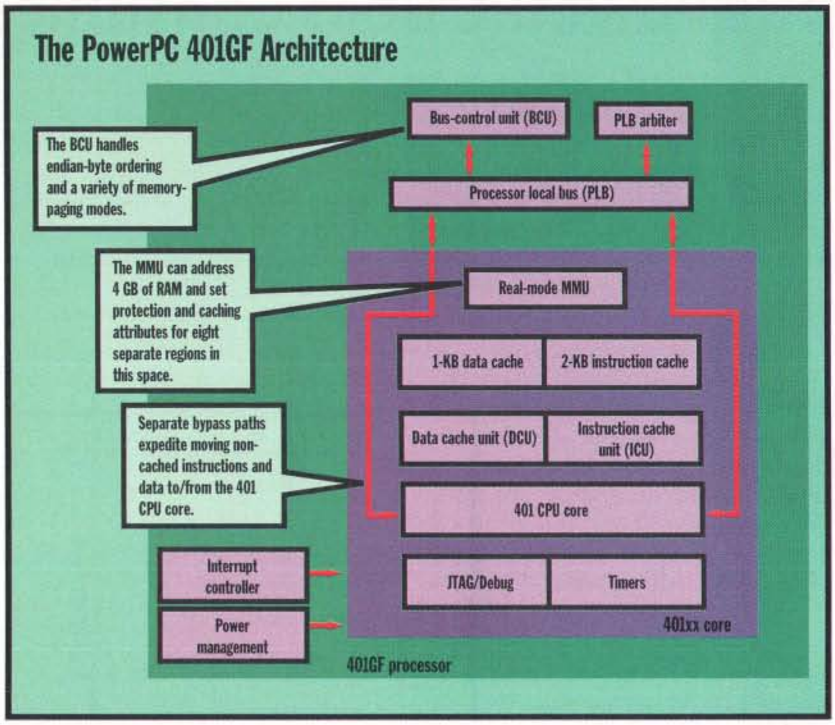
Both of the 401GF's cache units have data arrays, tags, and control logic for addressing and cache management. The 401GF uses a Harvard architecture and has a 1-KB data cache and a 2-KB instruction cache. (Custom 401GF implementations can be fabricated with caches up to 16 KB in size.) The small size of these caches is offset by the performance gained through the cache's two-way set-associative organization.

The DCU uses a copy-back strategy during cache operations to reduce bus traffic. This means that writes to main memory occur only for those data items that get modified in the cache. These updates take place when the altered data must be purged from the DCU in order to make room for new data. Control bits in the data-cache-control register can disable the cache for specific sections of memory.

Managing Memory

The 401GF has a sophisticated bus-control unit (BCU) that handles transfers among the external bus, the caches, and the registers within the processor core. The BCU can be programmed to handle a mix of 8-, 16-, or 32-bit devices. For example, in a set-top box, the BCU might use 8-bit accesses to fetch instructions from inexpensive 8-bit ROMs while performing 32-bit accesses to update a bank of DRAM that acts as a frame buffer.

The BCU has a programmable read/write burst mechanism that allows it to work with burst-mode ROMs and with page-mode DRAM to expedite cache-fill and flush operations. The BCU handles big-endian or little-endian byte ordering and supports transfers between it and external bus masters. This combination of programmable bus width, endian addressing modes, and read/write functions allows the 401GF to easily integrate with any type of peripheral or memory device, a plus for any design.


The PowerPC 401GF Architecture
The BCU handles endian-byte ordering and a variety of memory-paging modes.
The MMU can address 4 GB of RAM and set protection and caching attributes for eight separate regions in this space.
Separate bypass paths expedite moving non-cached instructions and data to/from the 401 CPU core.
Bus-control unit (BCU)
PLB arbiter
Processor local bus (PLB)
Real-mode MMU
1-KB data cache
2-KB instruction cache
Data cache unit (DCU)
Instruction cache unit (ICU)
401 CPU core
Interrupt controller
Power management
JTAG/Debug
Timers
401xx core
401GF processor

The 401GF uses the 401 core plus function units that handle interrupts and memory management.

The 401GF has a real-mode MMU. That is, the MMU handles memory protection and assigns access attributes to sections of memory, but it doesn't perform memory-address translation. (A virtual-mode MMU that addresses translation and memory paging is available for special purposes.)

Conserving Power

The 401GF uses a fully static CMOS design. This allows the processor clock to be switched off, putting the processor to sleep for power savings, yet the contents of its registers and its internal state are preserved. The 401GF can resume where it left off when an external event switches on the processor clock.

The 401GF has a programmable clock multiplier with ratios of 1:1, 2:1, 3:1, and 4:1. This lets the 401GF operate internally at higher clock rates for better performance while the system runs at a lower, less power-consuming frequency.

Like the PowerPC 603, the 401GF can selectively disable the clock to idle function units, which can further reduce power consumption. Also, you can issue commands to the SPRs so that the processor enters one of three power-conservation modes (nap, doze, or sleep).

At 25 MHz, the 401GF typically consumes 40 mW; it can be as little as 0.015 mW when it's in sleep mode. At this frequency, the 401GF can execute 44,000 Dhrystones per second, or 26 Dhrystone MIPS (DMIPS). Also, 50-, 75-, and 100-MHz versions of the 401GF will be available later this year as 3.3-V parts.

IBM has a library of various function units (e.g., a virtual-mode MMU, a digital signal processor or floating-point coprocessor, and a serial I/O interface) that you can add along with a 401 core to create a custom ASIC for a specific design. You can even add your own specialized logic, thus producing a high-performance 401-based ASIC for unique embedded applications.

Tom Thompson is a BYTE senior technical editor at large. He has a B.S.E.E. degree from the University of Memphis. You can reach him at **tom_thompson@bix.com**.

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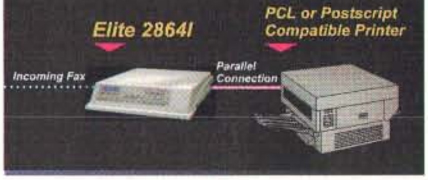
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A guide to using the Pentium's new multimedia instructions.

By Jonathan Khazam and Bev Bachmayer

Programming Strategies for Intel's MMX

Developing fast applications for Intel x86 processors is, in general, not difficult. However, an understanding of the processor's architecture makes the difference between a fast application and a slow one.

Intel processors that offer MMX technology add a new dimension to code development. The MMX technology is a set of highly optimized instructions for multimedia tasks that's included in Pentium processors scheduled to ship later this year. (For more on MMX, see "x86 Enters the Multimedia Era," July BYTE.) Software development cycles being what they are, developers need to start considering now where and how these MMX instructions can boost the performance of their applications.

Planning Considerations

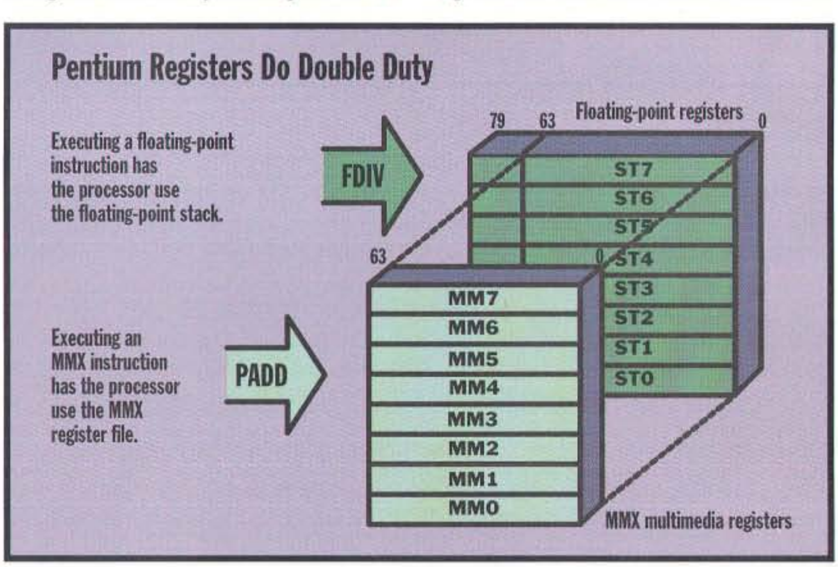
Before changing a line of code, the first thing you should do is profile your application. *Profiling* is the process of linking special libraries into your program or using system utilities to measure where your program spends most of its execution time.

Generally, you want to work on those code segments that are computationally expensive or that take a sizable percentage of the application-processing time. In multimedia and communications applications, such code sections typically include filters and speech-compression algorithms, video-display routines, and rendering routines.

In general, such routines consist of small, repetitive loops that operate on 8- or 16-bit integers. It is these routines that yield the greatest overall performance increase when converted to MMX-optimized code.

Such algorithms need to be analyzed for their fit with MMX instructions. The MMX technology adds 57 new op codes, designed to do high-speed arithmetic, logical, and comparison operations on packed data. As mentioned above, these MMX instructions offer the best support for 8- and 16-bit integer data types.

In some cases, it's possible to improve an algorithm's performance by rewriting it to use MMX instructions. For example, suppose a multimedia algorithm uses integer data. The first step is to use a profiling tool to identify which parts of the algorithm consume the most processor cycles. Once such "hot spots" are identified, you rewrite these code sections to use MMX integer instructions.


Pentium Registers Do Double Duty
Executing a floating-point instruction has the processor use the floating-point stack.
FDIV
79
63
Floating-point registers
0
ST7
ST6
ST5
ST4
ST3
ST2
ST1
ST0
63
0
MM7
MM6
MM5
MM4
MM3
MM2
MM1
MM0
Executing an MMX instruction has the processor use the MMX register file.
PADD
MMX multimedia registers

Register aliasing prevents you from using MMX and floating-point instructions at the same time.

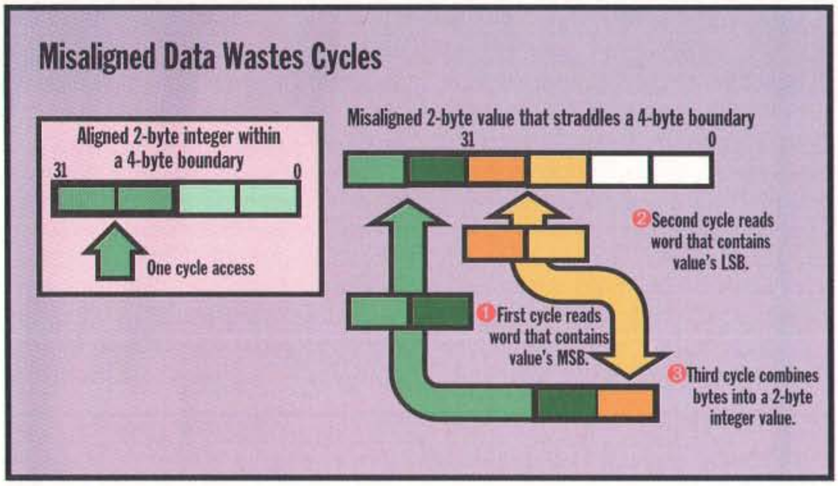
Floating-Point or Integer?

If an algorithm employs floating-point data, you should determine why it was used. Floating-point math is typically employed for one of two reasons. The first is for performance, since floating-point multiplies are about three times faster than standard integer multiplies in the Pentium. The second reason is that the algorithm in question requires a large range or lots of precision in its results.

If the algorithm uses floating-point math to obtain better performance, then it's certainly a candidate for conversion to MMX integer code. On the other hand, if the algorithm requires the range or precision that floating-point data offers, further investigation must be done. Can the algorithm's data values be converted to integer while maintaining the required range and precision? If so, you might rework the algorithm to take advantage of the MMX instructions.

When writing MMX code, it's important to keep in mind that the processor aliases the 64-bit MMX registers over the 80-bit floating-point registers, as shown in the figure "Pentium Registers Do Double Duty" above. This sleight of hand allows the addition of eight 64-bit, directly addressable MMX registers without adding any new processor states or compromising software compatibility.

Because the registers are physically the same, however, you can't store both floating-point data and packed-integer data in the same register at the same time. In addition, there's a small amount of processor overhead (several tens of clocks) when switching between floating-point and MMX instructions. To keep this overhead from sapping application performance, don't intermix floating-point and MMX code at the instruction level. If an application frequently switches between floating-point and MMX instructions, then you should consider extending the period that the application stays in either the MMX instruction stream or the floating-point instruction stream; this procedure will better amortize the switching overhead.


Misaligned Data Wastes Cycles
Aligned 2-byte integer within a 4-byte boundary
31
0
One cycle access
Misaligned 2-byte value that straddles a 4-byte boundary
31
0
❷ Second cycle reads word that contains value's LSB.
❶ First cycle reads word that contains value's MSB.
❸ Third cycle combines bytes into a 2-byte integer value.

Misaligned data can triple the number of processor cycles required to fetch data.

Because floating-point convention specifies that the floating-point stack be cleared after use, it's important to clear the MMX registers before issuing a floating-point instruction. The EMMS instruction is designed for just this purpose; it clears the MMX registers and sets the value of the floating-point tag word to empty (i.e., all 1s). This instruction is the MMX technology's equivalent of popping floating-point values off the stack to leave it empty. The EMMS instruction should be inserted at the end of all MMX code segments to avoid a floating-point overflow exception.

When writing an application that uses both floating-point and MMX instructions, use the following guidelines for best results.

- Partition the MMX instruction stream and the floating-point instruction stream into separate segments.
- Exit the MMX code section with the floating-point tag word empty (via the EMMS instruction).
- Leave the floating-point code section with an empty stack.
- Don't rely on the contents of the MMX or floating-point registers across context switches.

Maintaining Stack Alignment

```
Prologue:
        push    ebp                 ;save old frame ptr
        mov     ebp, esp            ;make new frame ptr
        sub     ebp, 4              ;make room for stack ptr
        and     ebp, 0FFFFFFFC      ;align to 64 bits
        mov     [ebp],esp           ;save old stack ptr
        mov     esp, ebp            ;copy aligned ptr
        sub     esp, FRAMESIZE      ;allocate space
... callee saves state, etc.
Epilogue:
... callee restores state, etc.
        mov     esp, [ebp]
        pop     ebp
        ret
```

Data Alignment

Data alignment is critical to optimal performance on Intel processors. Misaligned accesses add costly extra clock cycles to data-access times and sap performance. To see why this is so, see the figure "Misaligned Data Wastes Cycles" at left. If, say, a 16-bit integer value straddles a 4-byte boundary, it triples the number of cycles required to access the data.

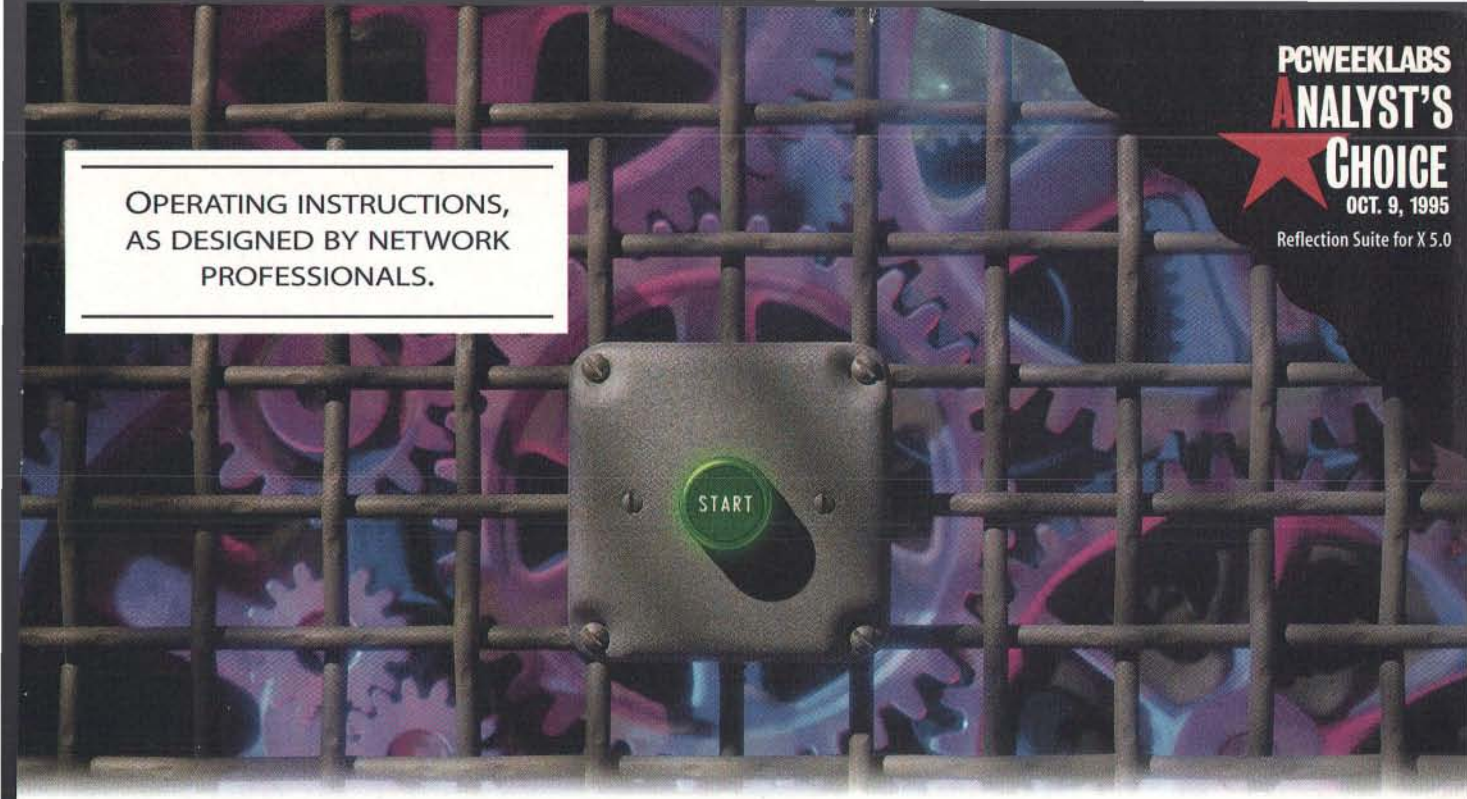
This problem is easily solved by simply respecting data alignment. Many compilers let you specify the alignment of variables using compiler controls. If a manual alignment of the variables is required, typically when allocating memory blocks on the fly, you can use the following C algorithm to force alignment. This routine aligns a 64-bit variable on a 64-bit boundary. Once it's aligned, every access to this variable saves three clock cycles (versus an unaligned access) on a Pentium processor.

```
if (NULL == (new_ptr = malloc
  (new_value +1)* sizeof
  (var_struct))mem_tmp =
  new_ptr;mem_tmp /= 8;
  new_tmp_ptr = (var_struct*)
  ((Mem_tmp+1) * 8);
```

As a matter of convention, compilers allocate anything that's not declared `static` on the stack. When making use of such volatile 64-bit data elements, it's important to ensure that the stack is aligned. The C code in the listing "Maintaining Stack Alignment" (at left), when placed in the function's prologue and epilogue, can force stack alignment.

As you can see, using MMX technology to speed program execution is fairly straightforward. More on MMX technology, instructions, and coding techniques can be found at the uniform resource locator (URL) http://www.intel.com. **B**

Jonathan Khazam is the program manager for Intel's MMX technology program. Bev Bachmayer is a senior programmer in Intel's code-optimization group. You can contact them at **Jonathan_Khazam@ccm.sc.intel.com** *and at* **Bev_Bachmayer@ccm.imu.intel.com**, *respectively.*



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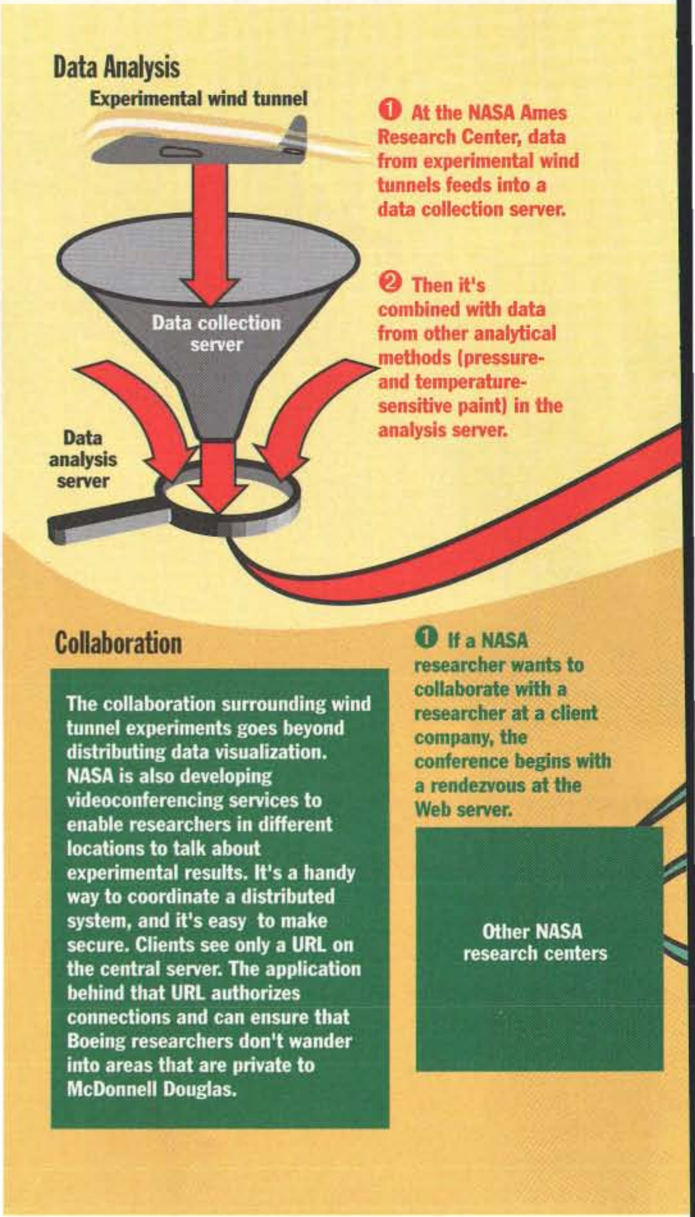
Web-smart, platform-independent applications are jump-starting a Golden Age of software development.

By Jon Udell



❶ At the NASA Ames Research Center, data from experimental wind tunnels feeds into a data collection server.

❷ Then it's combined with data from other analytical methods (pressure- and temperature-sensitive paint) in the analysis server.

The collaboration surrounding wind tunnel experiments goes beyond distributing data visualization. NASA is also developing videoconferencing services to enable researchers in different locations to talk about experimental results. It's a handy way to coordinate a distributed system, and it's easy to make secure. Clients see only a URL on the central server. The application behind that URL authorizes connections and can ensure that Boeing researchers don't wander into areas that are private to McDonnell Douglas.

❶ If a NASA researcher wants to collaborate with a researcher at a client company, the conference begins with a rendezvous at the Web server.

Can you really run your business on the Internet? You can't afford not to. As the planetary IP network increasingly connects your company to customers and business partners, the only question is: How can you best exploit the new opportunities?

Last year the World Wide Web looked like a great platform for electronic publishing. This year it became something far more profound: a planetary operating system. It's a primitive OS, to be sure, but so was MS-DOS when the IBM PC kicked off that great wave of software innovation. The Web's Common Gateway Interface (CGI), a sort of INT21 for the '90s, has created another tsunami. And this time, applications aren't confined to stand-alone Intel processors. They run on all kinds of computers, and they share code and data with computers anywhere.

The network really is the computer, finally. How can you use it? We've divided the answer into four parts. First, we explore the unique dynamics of the Web computing platform. Then we discuss how to integrate legacy systems with the Web. In part three we evaluate techniques for building Web server-based applications. We wrap up by exploring how Java, Sun's executable Web-page scheme, and ActiveX, Microsoft's OLE-replacing component scheme, will transform Web clients.

How to Exploit the Web's Dynamic Nature

Here's a Web application in its most basic form: You view a Web page in a browser, click on a hyperlink, and receive a new page from an application running on the server. From this simple model flow a number of obvious and not-so-obvious business benefits. First, the obvious ones:

Platform neutrality. A Macintosh, PC, or Unix browser can receive the same page in the same way from a Macintosh, PC, or Unix server.

Global availability. The browser and the server can be anywhere in the world—inches or continents apart, it makes no difference.

Automatic software distribution. The browser is (at least in first-generation Web applications) a universal client. No other software is needed. Given just the address of a Web application, any browser anywhere can run it. Users always run the current, latest-and-greatest version of that application.

And here are some subtler benefits to running your business on the Web:

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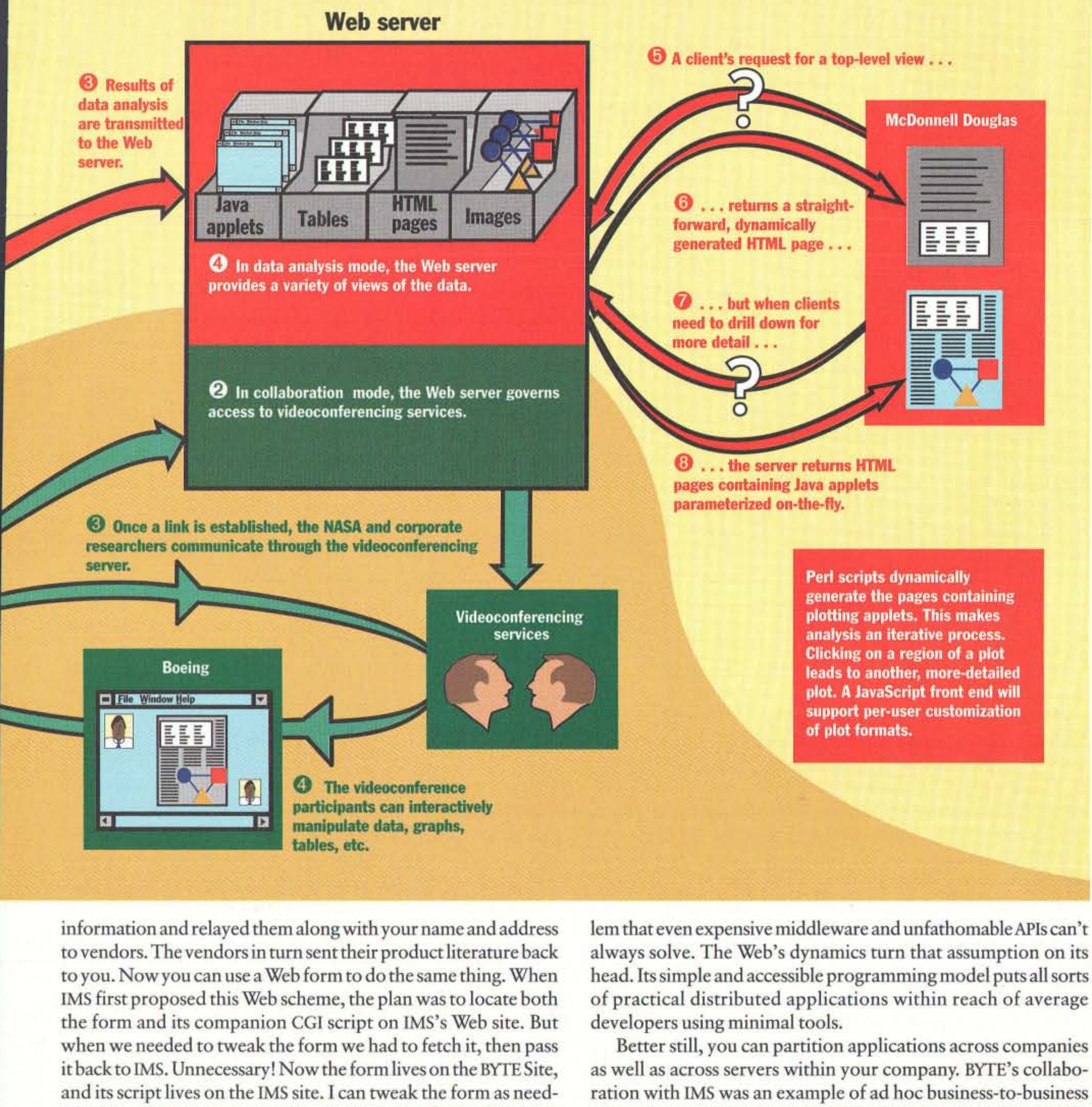
How NASA Distributes Data Visualization Using Java



③ Results of data analysis are transmitted to the Web server.

④ In data analysis mode, the Web server provides a variety of views of the data.

⑤ A client's request for a top-level view . . .

⑥ . . . returns a straightforward, dynamically generated HTML page . . .

⑦ . . . but when clients need to drill down for more detail . . .

⑧ . . . the server returns HTML pages containing Java applets parameterized on-the-fly.

② In collaboration mode, the Web server governs access to videoconferencing services.

③ Once a link is established, the NASA and corporate researchers communicate through the videoconferencing server.

④ The videoconference participants can interactively manipulate data, graphs, tables, etc.

Perl scripts dynamically generate the pages containing plotting applets. This makes analysis an iterative process. Clicking on a region of a plot leads to another, more-detailed plot. A JavaScript front end will support per-user customization of plot formats.

information and relayed them along with your name and address to vendors. The vendors in turn sent their product literature back to you. Now you can use a Web form to do the same thing. When IMS first proposed this Web scheme, the plan was to locate both the form and its companion CGI script on IMS's Web site. But when we needed to tweak the form we had to fetch it, then pass it back to IMS. Unnecessary! Now the form lives on the BYTE Site, and its script lives on the IMS site. I can tweak the form as needed as long as I preserve its interface to the script; that is, the names of the form variables and the URL of the script that processes the form.

Here's another example: The BYTE Site has evolved into a village of Unix and Windows NT servers. They partition the work of the site among them. One pumps out static Web documents; one runs CGI scripts; others provide mail, conferencing, application, and database services. None of this division of labor is obvious when you visit the site. URLs bind multiple servers into a cohesive whole.

We tend to think of distributed computing as a hard problem that even expensive middleware and unfathomable APIs can't always solve. The Web's dynamics turn that assumption on its head. Its simple and accessible programming model puts all sorts of practical distributed applications within reach of average developers using minimal tools.

Better still, you can partition applications across companies as well as across servers within your company. BYTE's collaboration with IMS was an example of ad hoc business-to-business network computing. In 1994 such a thing would have been difficult to imagine. In 1995, thanks to the evolution of the Web, it just happened—effortlessly.

What about the heavy artillery of distributed computing: transaction-processing monitors, object request brokers (ORBs), remote procedure calls (RPCs), and the rest? All this stuff still matters—more than ever before given the size of the audience to which Web applications play—but you can do simple things in a simple way.

You can support more users than you think. The Web's connectionless, page-at-a-time style of interaction can support lots

Four Reasons Why the Web Is Essential

✓ **It's open:** The Web is platform-neutral and global, and Web browsers function as universal clients.

✓ **It's resourceful:** Using the Web, you can update the look and the capabilities of legacy applications.

✓ **It's efficient:** Web-server applications are becoming simpler to create and faster to use.

✓ **It's dynamic:** Java and ActiveX can help you quickly build information-rich and customizable client applications.

of users—internal and external to your business. Every day, over 3500 visitors fetch more than 300 MB of data from our site's document server (an Alpha AXP/150) and run more than 2000 instances of scripts on its application server (a dual Pentium-90). These are not big numbers by Internet standards. But we haven't hit any real bottlenecks yet, other than bandwidth.

Can you imagine saying the same thing about a LAN client/server setup running on equivalent hardware? Thanks to HTTP's statelessness, you can cheaply deliver applications that serve thousands of users on your company's intranet and many more worldwide.

You can build customized, data-driven applications. Hypertext Markup Language (HTML) can express the basic widgetry of GUI applications—radio buttons, drop-down lists, multiline text boxes—and browsers can render those widgets. Is an HTML form a document or an application? Well, it's both, and more. Think of it as an active document, or a document-centric application. Either way, your browser's View Source function reveals that under the covers it's just an ASCII text file. People can write HTML texts quite easily. So can programs. Mixing human- and machine-written HTML leads to powerful synergies.

The BYTE Site's first application was a feedback form. I wrote a template for the form. Then I wrote a program to instantiate the template for each of the 5000 BYTE articles available on our site. When you comment on an article, the site presents a form specific to that article, then routes your feedback to the editors responsible for that article.

That's only the beginning. "Applications will reduce to sets of HTML pages that contain components," says Jeremy Allaire, president of Allaire (http://www.allaire.com), a vendor of tools that integrate Web applications with databases. Servers will build their business applications on the fly, selectively inserting and configuring components to match the user's identity and circumstances. It sounds like science fiction, but it's fast becoming reality. The corporate clients of NASA's Ames Research Center—Boeing, McDonnell Douglas, and other aerospace companies—use Web browsers to analyze wind-tunnel data collected at NASA (see "How NASA Distributes Data Visualization Using Java"). Pages generated for these clients contain Java applets used to visualize the data. NASA's system decides at run time which applets to insert into the pages, and how to parameterize them, according to the access privileges of each corporate client and the interests of each individual user.

You can find the information you need. It's been a truism that white-collar workers spend a shocking percentage of their time looking for documents. Suddenly that's changed. Last week I was looking for the latest Open Database Connectivity (ODBC) spec. Digital's AltaVista found it on the Net faster than I could have found it in my office on some CD. It also found the ODBC driver upgrade I needed and pointed me to Usenet discussions about the upgrade.

Successful application of full-text search on a planetary scale is so new that its implications have yet to sink in. "Not long ago, relatively few people had ever used full-text search," says Tim Bray, OpenText's cofounder and senior vice president of technology. "Now 40 million people use it on a regular basis."

The next frontier is fielded search. It's available now in a limited way on the Internet. In AltaVista, for example, you can issue the query "applet:spreadsheet" in order to find pages with Java spreadsheet applets. The <applet>..</applet> pair defines an implicit field, enabling a precise search for pages that actually contain Java spreadsheet applets, rather than ones that merely mention spreadsheet applets. In a recent BYTE Site survey we learned that aspiring Java programmers desperately want some sample code. AltaVista's "applet:" trick created a virtual Java code library out of thin air.

If the accidental structure that just happens to exist in the Web's document pool can yield such interesting results, what might intentional structure accomplish? The sky's the limit. On Qualcomm's intranet, 4500 employees share engineering and project-management documents using OpenText's LiveLink Intranet. A version of OpenText's Internet Web crawler scans and indexes documents. Users inject new documents into the system using LiveLink's work-flow manager, a Web application that's equally accessible to the 2000 PCs, 2000 Macs, and 500 Unix workstations in the company. As it receives documents, it tags them with user, date, and project fields. This additional structure vastly improves search capability, especially since many of the engineering documents don't translate to HTML and store as PDF files instead.

Integrating Legacy Systems

The Internet's frenzied evolution is redefining the term "legacy system." A few years back, the term referred to the mainframe application you replaced with a PowerBuilder and Sybase client/server solution running on a LAN. Today, as likely as not, it's the client/server system itself that your company is targeting for recycling—this time into a Web-based business application.

Some pioneers today are going all the way, building client and server logic using pure Java and/or ActiveX (formerly OCX) technologies. Yet if you scratch the surface of most major Web applications, you'll find some familiar items: middle-tier logic written in 3GL or 4GL languages, talking to transaction services or talking directly to data stores.

Why put a Web face onto an otherwise unmodified legacy application? First and foremost: To let business customers serve themselves. Federal Express drove home the point when it exported its mainframe-based package-tracking application

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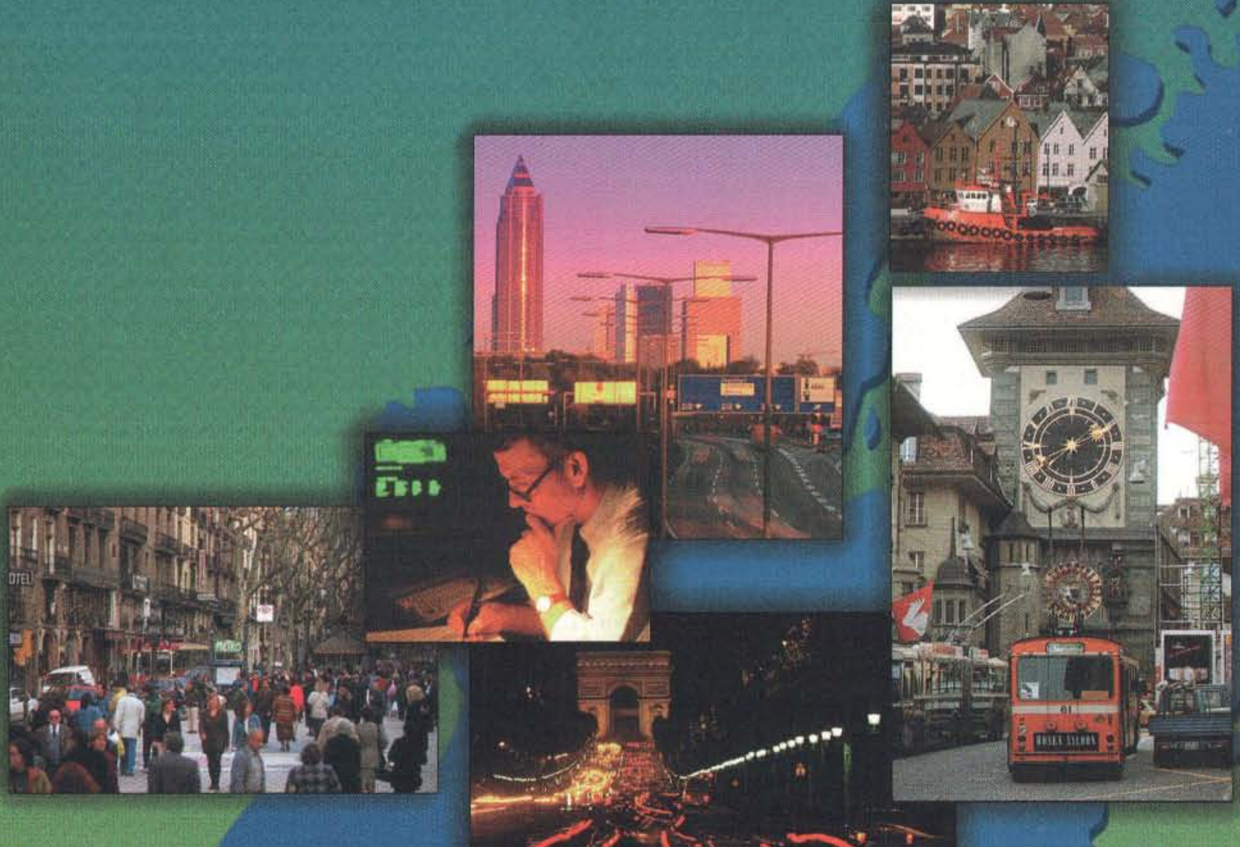

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The Firewall Dilemma: Too Few Locks, Too Many Doors

People who've used TCP/IP networks for a long time find the current fuss over intranets, firewalls, and the Internet a bit perplexing. It's all just good old IP networking, right? Well yes, but when a cozy community becomes a bustling megalopolis, people have to lock their doors. The problem is that every single node of a TCP/IP network is a door. McGraw-Hill, BYTE's parent, is busily installing 10,000 of these doors. Unfortunately, there is not yet a practical way to lock them all, so like many companies, McGraw-Hill locks the one that connects its global private WAN to the Internet. That's the only rational choice today, and I'm grateful for it, but it still stinks. When I recently moved BYTE's LAN behind McGraw-Hill's firewall, all sorts of things broke: POP3 mailbox access, NNTP conferencing, RealAudio, and every other non-HTTP application.

We have gotten RealAudio back again, and I'm working with McGraw-Hill's provider, ANS, to restore POP3 and NNTP. It's all doable with the right combination of packet filters and application gateways. But while you can bless a whole series of protocols and applications with the ability to penetrate firewalls, that won't solve the two real problems:

Problem #1: *There are no safe protocols.* If you think HTTP is benign, think again. Simson Garfinkel, author of *Practical UNIX and Internet Security*, sketches out several ways to attack a firewall that's permeable only to HTTP. Here's one: Convince people to download a Netscape plug-in that silently relays secrets to a rogue server outside the firewall. "The plug-in could do anything at all, even run a packet-sniffer on your LAN," says Garfinkel.

Problem #2: *There are too many doors.* A perfect firewall is not the answer. Just about any Mac, PC, or Unix workstation can bypass the firewall by dialing the Internet directly. You can't police them all. Insiders, sometimes knowingly, represent the worst threat.

Beyond Firewalls: The Virtual Private Network

IPsec, now in gestation, looks like a good answer. It's a secure form of TCP/IP, encrypted from end to end. The first crop of implementations, built by firewall vendors, are now entering the interoperability test phase. They will enable secure use of any standard IP application for business-to-business networking. Why is that important? The Web is hot, but there is much more to distributed computing—sockets, remote procedure calls (RPCs), Internet inter-ORB protocols (IIOPs). You would like to be able to do all these things safely on the public Internet.

Firewall-based secure IP will not, however, deter deliberate or accidental sabotage from behind any of the firewalls participating in this kind of virtual private network. What would? Desktop-based secure IP. The kind of end-to-end encryption that's available now at the application level—between secure Web servers and Web browsers, or between Notes servers and Notes clients—could, in theory, migrate down into the TCP/IP stack on your workstation. Any IP application could then communicate securely within and across corporate boundaries. But don't hold your breath. Gateway implementations of secure IP have yet to prove themselves computationally and administratively feasible. Desktop implementations are even further off.

Coping Strategies

While you're waiting for secure IP to arrive, here are some interim solutions:

Piggyback on HTTP. When you have only a hammer, everything looks like a nail. Likewise when the Internet industry decides that HTTP is the "safe" protocol, every application starts to look like an HTTP application. "We're taking higher-level protocols like DCOM and putting them on top of HTTP in order to get through firewalls," says Bob Muglia, Microsoft's vice president for development tools. "It's crazy, but HTTP has become a legacy thing like MS-DOS."

Use Lotus Notes. A Notes network riding on top of the Internet can be a highly secure virtual private network for geographically dispersed employees and business partners. To reach customers outside the Notes environment, use Internotes WebPublisher to export access to data and applications.

Encrypt your e-mail. This is currently harder than it should be. Implementations of Pretty Good Privacy (PGP) have been available for years, but none yet integrate into popular mail programs such as Eudora and Netscape Navigator. A number of e-mail vendors now plan to support an alternative scheme, Secure Multipurpose Internet Mail Extensions (S/MIME), but no S/MIME mailers are available yet, either.

What's the holdup? Nobody wants to get busted for violating U.S. restrictions on export of cryptographic technology, says Simson Garfinkel. Still, it's likely that secure mailers will soon be prevalent. Secure SMTP will be a useful transport for many applications.

Exploit other secure applications. Netscape has added secure socket layer (SSL) support to its news server and client. Kerberos-enabled versions of mail, FTP, and other applications are available. These kinds of solutions lack the universality that makes standard Web applications so appealing. But they do exist.

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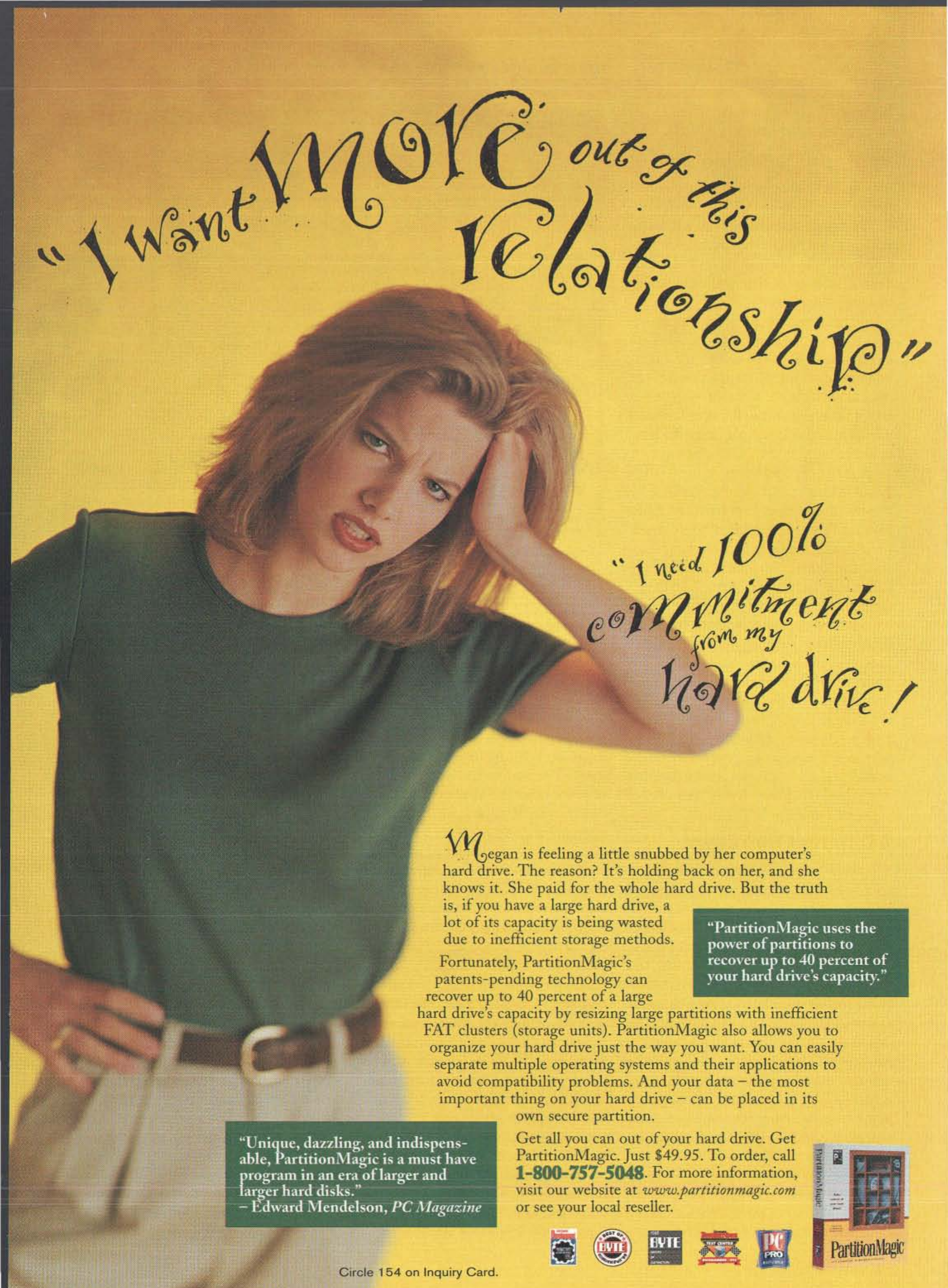
to the Web. Anderson Windows plans something similar for its inventory system, built using Forte Software's client/server toolkit. Today, Anderson Windows has to pay an employee to run the Forte application on behalf of customers. "That's inefficient if you need a $6 part but it costs [Anderson Windows] $60 to look it up for you," says Ed Horst, director of product marketing for Forte.

Anderson Windows and other businesses now aim to create dual-mode applications. In this model, a less-functional Web version exports a simple self-service capability directly to customers. The full-featured LAN client/server version remains available to employees, who can spend less time acting as application gateways and so (one hopes) more time on nonroutine customer service. Both versions share common middle-tier services such as pricing logic. In concept, this approach resembles the computer telephony systems that companies use to let customers serve themselves via interactive voice response.

Put on the Best Web Face

Ponytailed Web design consultants in expensive suits will tell you your Web application must use frames and Java-enabled animation to attract an audience. Fire them. The name of the game is access. Southwest Airlines recently fielded an application you can use to book flights over the Web (see http://www.iflyswa.com/). "We found that most of the world is running Windows 3.1 at 640 by 480," says senior engineer Steve Taylor. "We set the bar at Netscape 1.2 because people want to book flights, not download browsers."

On the other hand, if you can dynamically adapt to the user's (that is, the potential customer's) browser, you should. JAM/WEB, which Web-enables applications built using JYACC's (http://www.jyacc.com/) three-tier development tool JAM, will emit JavaScript to perform client-side data validation if the browser is capable. "On Netscape 1.x, we know we can't do that," says Charles McGuinness, JYACC's director of technical marketing,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"so we fall back to plain HTML and validate on the server side."

Appropriate Technology

Almost any kind of tool can support a Web business application. I wrote my first non-Perl Web application using Next's WebObjects on a Dell P90. I've always liked Objective-C and the Next libraries but could never effectively deploy applications built this way. Now I can.

Object Design Inc.'s ObjectStore manages the complex fare and schedule data that supports SouthWest Airlines' flight-booking application. Transactions still go back to the legacy reservation system, but ODI's object database handles fare and schedule queries a lot faster than the legacy system could.

A business application built with JYACC's JAM can straightforwardly convert into a replicated, load-balanced, fault-tolerant Tuxedo service. JAM/WEB extends these Tuxedo benefits to Web clients.

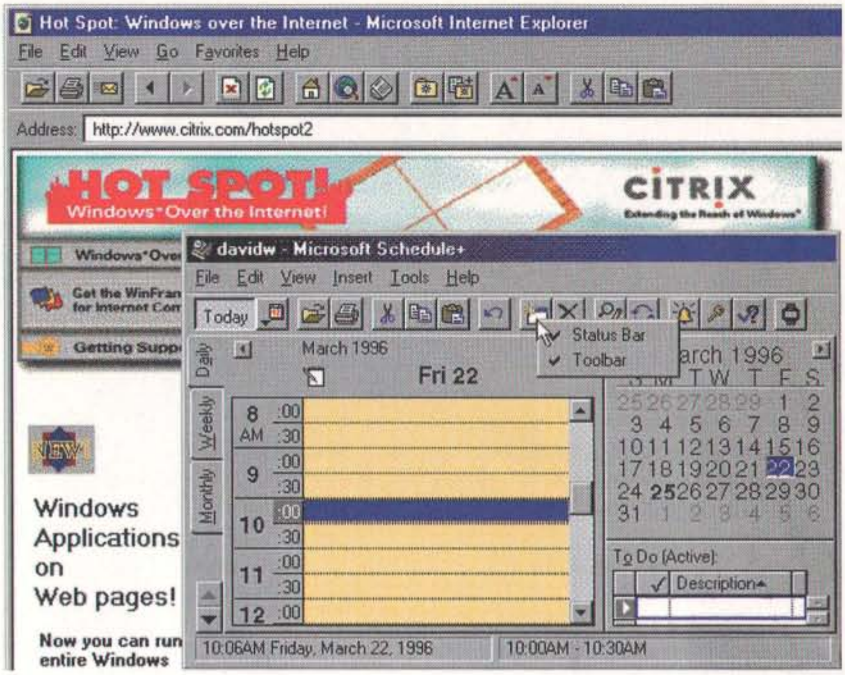
Lotus Notes, with InterNotes WebPublisher, supports many of the Web development projects tackled by Entrevision, a Canadian systems integrator. "Now that WebPublisher supports interactive forms as well as static pages," says Entrevision partner Steve Carroll, "it's the ideal development tool for the Web."

WebObjects, ObjectStore, Tuxedo, Notes—the list could go on forever. When you need to squeeze more life out of legacy data and applications, pick the tool that works best. If it doesn't have a Web adapter yet, wait a month.

A Different Thin Client

The Web's explosive growth owes much to the thinness and universality of browsers. Mosaic or Netscape, plus an IP link, was all your Mac, PC, or Unix workstation needed to access everything the Web could offer. Still, as anyone who has recently downloaded a Microsoft or Netscape browser knows, both thinness and universality are now endangered. The disk and RAM footprints of these browsers grow at an alarming rate. As browsers acquire more moving parts (plug-ins, downloadable applets and controls), they begin to suffer from the same problems that plague desktop OSes: memory strain, configuration conflicts, unreliability.

There's no stopping progress. Integration of advanced client-side componentry into browsers is a good and necessary thing. Nevertheless, you'd like to have the option to deploy real GUI business applications over the Web without heaving so much complexity over the wire to the client. The answer is nothing new: Use a remote GUI. The application runs on box A, but the application's GUI displays remotely on box B. X Window is one way to project a GUI application through a network. The remote GUI approach is fine, provided that the application you want to run is an X application and there is enough bandwidth between the X client and server (X needs a lot of bandwidth).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Citrix WinFrame lets you use Windows—in this case, Microsoft Schedule is running—remotely over the Web.

A newer and more mainstream option is Citrix's WinFrame. This is a multiuser implementation of Windows NT. WinFrame features remote GUI projection over the Web or a LAN to DOS, Windows, and (soon) Mac clients. This setup needs less bandwidth than X, and it plays all Win16 and Win32 applications. The latter run natively on the application server, exploiting the DLL architecture of most Win32 programs to share code across many concurrent instances. Add the Citrix client (a 122-KB download) to your browser and you can launch server-side Win32 applications that display on the client, either in the browser or in a separate window.

How might you actually apply this technology to your business? Suppose your field sales force enters their orders into a Lotus Approach application, generates reports, and e-mails those reports to headquarters. You've been meaning to convert to a client/server application to eliminate the data transfer step. A Web-style intranet application is one option—but you have to create it. Alternatively you might use Citrix's WinFrame to colocate the existing Approach application with its data at headquarters and project its GUI to the remote sales force.

Can you scale this business solution? Sort of. You're constrained by the number of concurrent sessions the application server can push. You wouldn't use this approach to let visitors to your public Web site search your inventory. But for a private application with a few dozen concurrent users, it might be just the ticket. Citrix has announced a clustering solution that will spread the processing load across a farm of application servers. If this pans out, your sales-force application could scale to hundreds of users or more.

Can you manage this solution? Absolutely. It plays on a minimal client—a 2-MB 386/20 running Windows 3.1 works as well as a 16-MB Pentium 90 running NT. The machine needs only the universal Citrix client and a network link. When you upgrade the application, it's automatically available to everyone. These are exactly the benefits that, we may soon be complaining, Web browsers used to deliver.

continued

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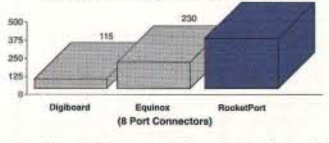

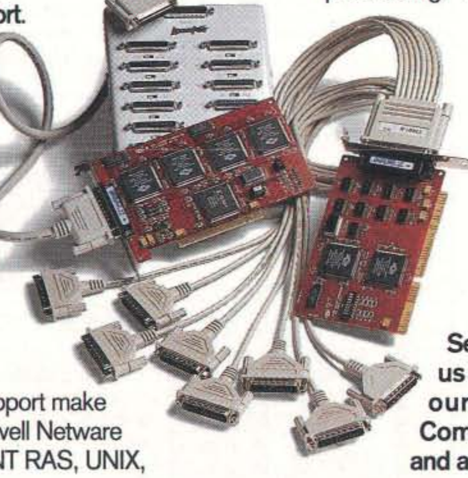

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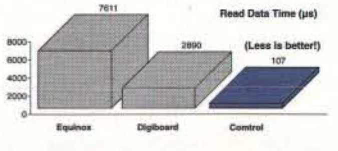

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Building Web Server-Based Applications

Pre-Web, there were really two kinds of programs. Console applications read text from and printed text to a character-mode console; GUI applications read events from a queue and painted text and graphics on a bit-mapped screen. A Web application is a curious mixture of these styles. It reads and writes text just like a console application does. But the text it writes—HTML—describes how to render text and graphics on a bit-mapped screen. A Web application is, from this perspective, something like a PostScript driver.

Perl was the language of choice for first-generation Web-server applications, in part because its powerful string-processing features make it a snap to create and manipulate HTML texts. Other reasons were free availability on all platforms, rapid development thanks to interpreted execution, and direct support of IP network APIs including sockets.

As Web developers became more ambitious, and as traffic to Web sites grew, the Perl method began to show signs of strain. When you run a CGI program that's implemented in Perl, you're subject to two bottlenecks. First, you have to launch a process in which to run the Perl interpreter, which in turn runs the Perl program. Creating that process once an hour or once a minute is not a problem, but creating it 10 times a second is. Next, you have to wait for the Perl program to send back the page it generates as output. Waiting for a 20-line Perl script that does something simple is not a problem, but waiting for a 2000-line script that does fancy stuff is.

Break the CGI Bottlenecks

Solutions are at hand for both of these bottlenecks. To eliminate process-creation overhead, Web server vendors have created APIs that your back-end applications can use to share a process with the Web server. Netscape's Netscape Server API (NSAPI), Microsoft's Internet Services API (ISAPI), Apache's modules, and O'Reilly's WebSite API (WSAPI) all provide you with ways to shoehorn applications into the server's address space.

Vendors of Web server-based applications that comply with these mechanisms like to make extravagant performance claims. But it's not so simple. It is expensive to create a process. It's much more expensive, though, to load a monster application into that process. The solution here is to divide the application into two parts. The user invokes a transient, lightweight stub. It transmits a request to a long-running daemon process (Unix) or service (NT) which does the real work. This translates into real speed. "We saw a 10x improvement when we went to this [stub-and-daemon] architecture," says Nanda Kishore, vice president of engineering for Spider Technologies. How does this compare to the API approach? "Converting to NSAPI and ISAPI yielded only another 25 percent improvement."

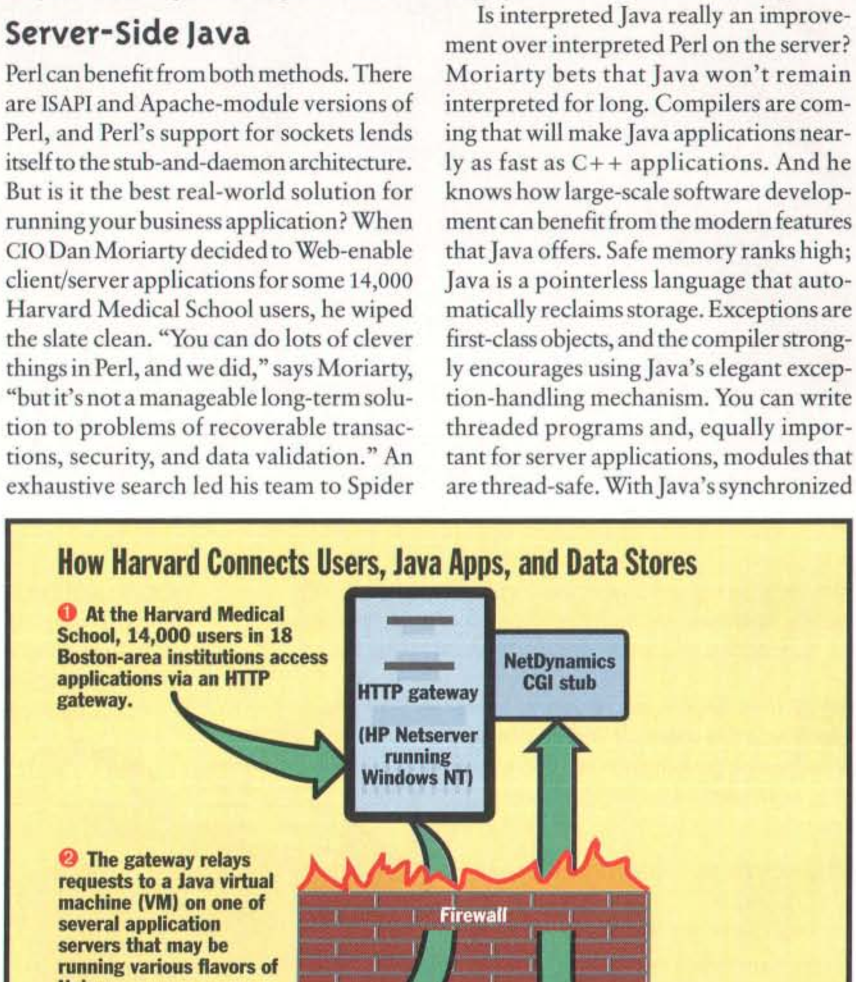
Server-Side Java

Perl can benefit from both methods. There are ISAPI and Apache-module versions of Perl, and Perl's support for sockets lends itself to the stub-and-daemon architecture. But is it the best real-world solution for running your business application? When CIO Dan Moriarty decided to Web-enable client/server applications for some 14,000 Harvard Medical School users, he wiped the slate clean. "You can do lots of clever things in Perl, and we did," says Moriarty, "but it's not a manageable long-term solution to problems of recoverable transactions, security, and data validation." An exhaustive search led his team to Spider Technologies' NetDynamics. It runs Java applications on a dedicated application server, within a framework that connects those applications robustly to users and to data stores. (See "How Harvard Connects Users, Java Apps, and Data Stores.")

Two key points sold Moriarty on NetDynamics. First, it offers a productive 4GL-like tool that generates accessible and extendable Java code. Second, it provides Java wrappers around session management, security, and database services, so they, too, can be modified or replaced.

Is interpreted Java really an improvement over interpreted Perl on the server? Moriarty bets that Java won't remain interpreted for long. Compilers are coming that will make Java applications nearly as fast as C++ applications. And he knows how large-scale software development can benefit from the modern features that Java offers. Safe memory ranks high; Java is a pointerless language that automatically reclaims storage. Exceptions are first-class objects, and the compiler strongly encourages using Java's elegant exception-handling mechanism. You can write threaded programs and, equally important for server applications, modules that are thread-safe. With Java's synchronized

How Harvard Connects Users, Java Apps, and Data Stores



❶ At the Harvard Medical School, 14,000 users in 18 Boston-area institutions access applications via an HTTP gateway.

❷ The gateway relays requests to a Java virtual machine (VM) on one of several application servers that may be running various flavors of Unix.

❸ Spider's NetDynamics session manager maintains persistent state, for each user, across a series of HTTP transactions.

❹ The NetDynamics development environment includes the Rogue Wave database library, which talks to a Sybase data store.

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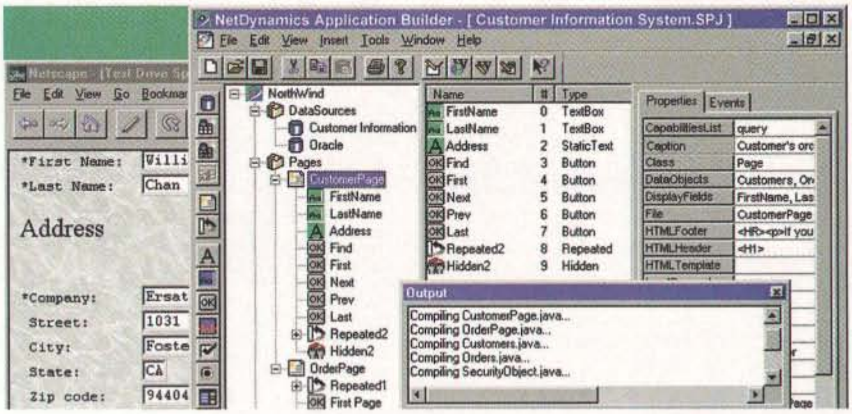
keyword you can declare methods, or even individual variables, to be critical sections. And you can do so portably, without reference to the OS-specific APIs usually needed to make modules reentrant.



*First Name: Willi
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City: Foste
State: CA
Zip code: 94404

Name	#	Type
FirstName	0	TextBox
LastName	1	TextBox
Address	2	StaticText
Find	3	Button
First	4	Button
Next	5	Button
Prev	6	Button
Last	7	Button
Repeated2	8	Repeated
Hidden2	9	Hidden

CapabilitiesList	query
Caption	Customer's orc
Class	Page
DataObjects	Customers, Or
DisplayFields	FirstName, Las
File	CustomerPage
HTMLFooter	<HR><p>If you
HTMLHeader	<H1>
HTMLTemplate	

```
Compiling CustomerPage.java...
Compiling OrderPage.java...
Compiling Customers.java...
Compiling Orders.java...
Compiling SecurityObject.java...
```

Spider Technologies' NetDynamics lets you run Java applications within a framework that connects those applications to users.

Understanding Java and ActiveX

Web pages have always been active documents. But they're about to get a lot more active as Java applets and ActiveX components begin streaming down the wire to the latest Netscape and Microsoft browsers.

There are two levels where developers can add client-side behavior to a Web page: scripts and components. On the scripting front, Netscape's Navigator offers JavaScript, and Microsoft's Internet Explorer will have VBScript. Given a script on an HTML page, either script language can interact with the page's widgets and with the browser's environment. The classic example for business is local validation. Imagine a form that collects, among other facts, your credit card number. With vanilla HTML there is no way to check the number; the whole form must go to a server-side script that checks it all at once. With JavaScript or VBScript, a client-side function can compute the card number's check digit, wire it up as the field's onExit method, and present a GUI message box in case the check fails.

On the component front, Navigator offers Java, and Internet Explorer supports ActiveX. Given an HTML page referring to a component, either browser can fetch it, allocate a display region for it, and run it. The classic business example is a spreadsheet widget. Rather than deliver raw data in an HTML table, furnish analysis—as a spreadsheet, linked to a data source and including analysis rules and procedures. That's a job for Java or ActiveX. Both of these approaches offer the two essentials for Web businesses: network APIs to fetch the data and GUI APIs to render it.

How Java Beats ActiveX

You can't actually compare Java, a programming language, to ActiveX, a component framework. The real comparison is between the components that play in Netscape browsers versus those that will play in Microsoft browsers. You are likely to prefer Java-style components if:

1) You prize portability above all. To deliver applications to the widest browser audience, Java's the ticket. The Java-enabled browser's virtual machine (VM) plays an applet's bytecodes identically on x86, PowerPC, Alpha, PA-RISC, and SPARC CPUs. The Java abstract windowing toolkit (AWT) likewise renders GUI widgetry in system-appropriate ways on Windows, Mac, and X Window systems. For NASA's Dave Korsmeyer, a senior software engineer, the portability requirement mandated Java to distribute wind-tunnel data analysis to Windows PCs, Macs, and SGI, HP, and Sun workstations.

2) You value a common object-oriented language for components and glue. OOP fans have rightly pointed out that VBX and OCX components sacrifice inheritance for reuse. The same is true for their successors, ActiveX components. With the HTML component in Microsoft's Internet Control Pack, for example, you can create a simple Web browser with a single line of Visual Basic code. Try it! But there's a trade-off. Although you build the component with C++ classes, you can't extend those classes. You can only twiddle its exported properties, and call its exported methods, using Visual Basic, Access, or another ActiveX-aware host. An interface separates the language that implements components (C++) from the language that glues them together into applications (VB). This was an intelligent decision by Microsoft, kicking off an entire component industry. But it was a trade-off nevertheless.

Enter Java. Sun's language designers evidently paid close attention to the debate raging over inheritance vs. interfaces. The result: a language that embraces both. Java supports single inheritance, and its library includes a Component class (ancestral to Window, Dialog, and Frame) that you can extend using inheritance. But Java also supports interfaces. Suppose you extend Dialog to create a class TaxDialog with subclasses 1040Dialog and 1040EZDialog, each having its own special data-validation logic. You can define a TaxDialogValidator interface and implement it once for each subclass of TaxDialog. This is simpler and cleaner than OLE/COM's technique to avoid the multiple inheritance hassle. Unlike OLE/COM, with no implementation inheritance, 1040Dialog and kin do inherit common look and behavior from TaxDialog. Anyone who faces the challenge of maintaining a system with bales of business-vital forms will appreciate this powerful and intensely practical application of OOP.

There's more. The OLE/COM/ActiveX model sharply divides component builders from component assemblers. The former build black boxes using C++, the latter wire black boxes together using VB. Again, there is a trade-off in this productive division of labor. You must decide up front how much to encapsulate in the component, and how much to leave for the glue language. Unfortunately, that's hard. But if functions can migrate both into and out of the component as a project evolves, that's helpful. A common language for components and glue makes this possible. NextStep programmers have been exploiting this synergy for years. Java programmers will, too.

How ActiveX Beats Java

You are likely to prefer ActiveX components if:

1) You want the fullest exploitation of Windows APIs. Cross-platform GUI frameworks are problematic at best, and Java's AWT is currently nowhere near the best. In

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Java and ActiveX

JAVA PROS	**CONS**
Portable	Cross-platform GUI framework in rough shape
Same language for components and glue	Component framework is missing
Can use inheritance and interfaces	For advanced programmers only
Multithreaded reentrant applications, robust exception handling	For advanced programmers only
ActiveX PROS	**CONS**
Components fully exploit Win32	Won't run in Mac or Unix browsers
Easily assembles applications	Can't extend components with inheritance
Can use Access and Visual Basic	No threading, synchronization, or exception handling
Applications can integrate desktop and Internet resources	Presumes Windows and Microsoft Foundation Class support for DocObject model

environments where Windows rules, ActiveX is compelling. UCC, a Dutch consultancy, has been working with Siemens on a large distributed car-sales application built from OCX components wired together using VB 4's remote OLE automation. Nico DeVries, manager of UCC's client/server division, sees ActiveX as the natural extension of this model. The OCX componentry already delivers rich Win32 behavior on the client side and robust communication with SQL data sources. ActiveX promises to simplify the distribution of components by automatic download.

2) You value a common component-oriented framework for LAN and Internet applications. Today these two breeds stand far apart. But the Internet is really just a very big and very slow LAN. ActiveX components ride on a support layer that unifies these two kinds of network. Services include caching, reliable data transfer over slow links, and a single namespace for LAN and Internet resources.

Microsoft is defining a sophisticated two-tier component architecture. On one level, an application is made of components that talk to each other, to LAN resources, and to Internet resources. On another level, containers manage classes of data and the applications that render those data types. Internet Explorer 3.0 and the next Windows 95 shell, code-named Nashville, will be two such containers. Nashville will be a universal browser in which all top-level views are dynamically generated HTML pages, Microsoft says. You'll be able to bookmark c:\foo.doc the same way you bookmark http://www.foo.com/foo.doc and view either in a directory-tree listing à la the current Win 95 Explorer. Click on either, and the shell will transfer control of its document-viewing pane to Word (or another application that supports this data type and complies with the DocObject interface that enables this kind of containment). Suddenly you're viewing *and editing* a LAN *or Internet* document. This scheme promotes OLE 2.0 in-place editing from the application level to the system level. And it globalizes the sources of data you can edit.

A Few Caveats

Neither of these technologies is fully cooked yet. What Java lacks most glaringly is the sophisticated component framework that the Windows platform has evolved. You can write components in Java, but it's unclear how you will package and distribute them, or what VB-like assembly environment will support them. One intriguing possibility: VB. Microsoft has worked aggressively to support Java. The Java VM in Internet Explorer 3.0 now packages Java classes as COM objects. This, Microsoft claims, will allow bidirectional interoperability between ActiveX and Java components. The newly defined ActiveX scripting architecture, moreover, will enable containers to control embedded components using any compliant script engine—initially VB, VBScript, and JavaScript, but potentially full-blown Java. Microsoft might be able to define the framework that Java components play in. "This is the critical issue for Java at this juncture," admits Miko Matsumora, a JavaSoft software engineer. JavaSoft is working to define an alternative, Windows-neutral component architecture for Java.

What ActiveX lacks most glaringly is portability. Internet applications are, almost by definition, groupware applications that connect people to each other and to information. You wouldn't install a phone system that reached only 90 percent of your people or your customers. And you probably won't want similar constraints on an Internet-based software system that you deploy company-wide or globally. A "Download Windows 95 now to view this Web page" button just won't cut it.

Because ActiveX is a descendant of OCX, which relies heavily on the Microsoft Foundation Class (MFC) library and Win32, any hope for portable ActiveX components would appear to hang on the portable implementations of these subsystems. And while Win32 and MFC libraries exist for Mac and Unix systems, they don't yield first-class applications. Microsoft claims, however, that ActiveX components don't depend on Win32 and MFC. Doug Donzelli, vice president of engineering for NetManage, codeveloper of Microsoft's Internet Control Pack, confirms half this claim: "It's true: The Internet controls do not call the MFC DLLs." How is this possible? Magic Wand, an alternative application framework, supports creation of non-MFC-dependent components. Still, portability of ActiveX componentry remains speculative.

The Age of Possibility

Two years ago, deployment of information-rich, platform-neutral, dynamically customized applications on a global enterprise scale seemed an impossible dream. Today it happens routinely.

Microsoft and Netscape are battling to dominate the new era. But unlike past OS wars, they're fighting this one on the common ground of Internet protocols and standards. Decades in the making, those protocols and standards really work—and they're improving every day. Every CIO and engineering VP interviewed for this story echoed the same sentiment: The software business is reborn.

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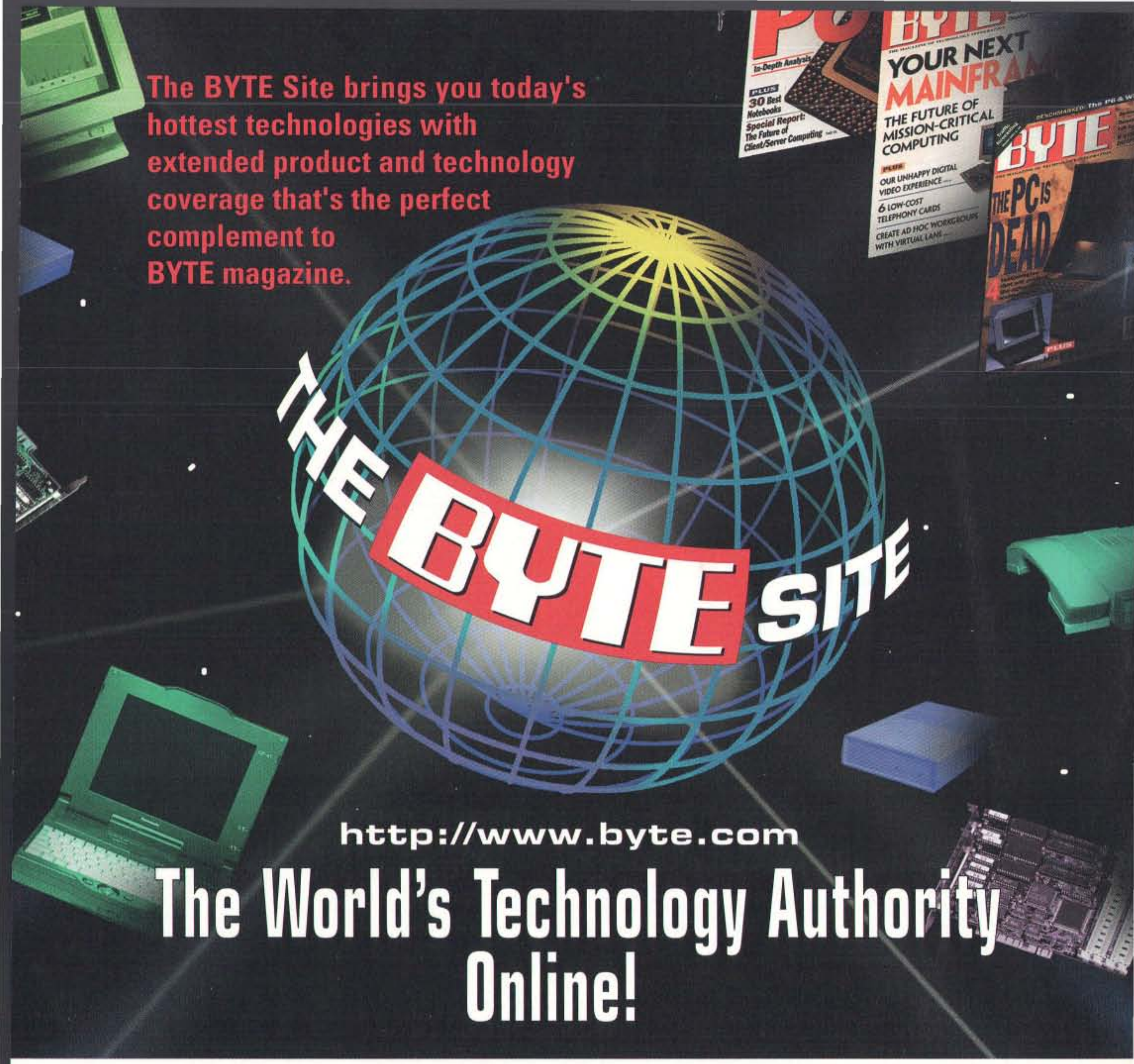
*Jon Udell (**judell@bix.com**) is BYTE's executive editor for new media.*



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Is ATM Ready to Catch Fire?

Technology advances and falling prices may turn ATM's potential for high-speed communications into corporate reality.

If Broadway's Annie grew up to be a network administrator, she might cynically start singing "Tomorrow" every time someone mentioned asynchronous transfer mode (ATM). After years of hearing about the technology's potential, it's easy to conclude widespread corporate acceptance of ATM is "only a day away."

Nevertheless, there are signs of change. What's different this time around? Key technologies have matured to make ATM worthy of consideration for near-term networking strategies.

First of all, switches and adapter cards now offer a wider range of data rates—from over 1 Gbps down to 25.6 Mbps—which means network administrators can match bandwidth to the specific needs of each network segment. Some corporations are finding that this scalability makes ATM an efficient way to replace central mainframes with distributed client/server clusters or to give select workgroups the bandwidth they need for multimedia applications. To decide if the time is right for you to explore this technology, see "Are You Ready for ATM?" on page 85.

If you decide that ATM is part of your near-term plans, you'll need to assemble the right hardware and software components for this switched-network architecture. The good news is that you no longer need to be Daddy Warbucks to afford ATM switches and adapter cards. Some of the latter, for example, now sell for prices within the range of expensive Ethernet cards (see "Virtually Well Connected," page 93).

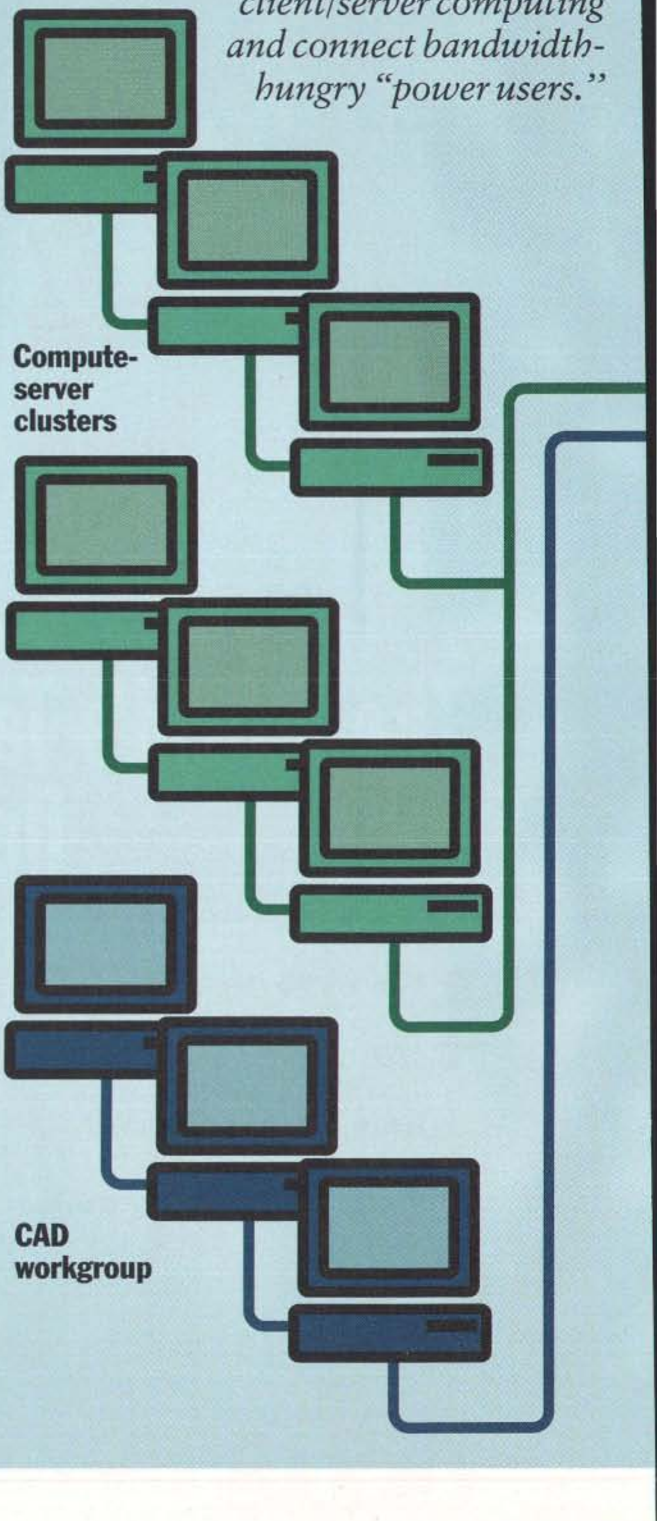
But don't conclude that economics has been the only stumbling block to widespread acceptance of ATM. There is still a dearth of applications that can take full advantage of ATM's characteristics. One big problem is the continuing lack of a standard API that developers can write to for cross-platform applications. We're still waiting for this programming target. But in the meantime, three alternatives exist to help you tie Windows, NetWare, or Unix clients into an ATM network. "Teach Your Apps to Speak ATM," on page 97, tells you what tools are available for each environment.

In the end, large-scale ATM implementations will not be here tomorrow. A year or two from now is more likely. But the rehearsals for the big time may finally be coming to an end.

–By Alan Joch

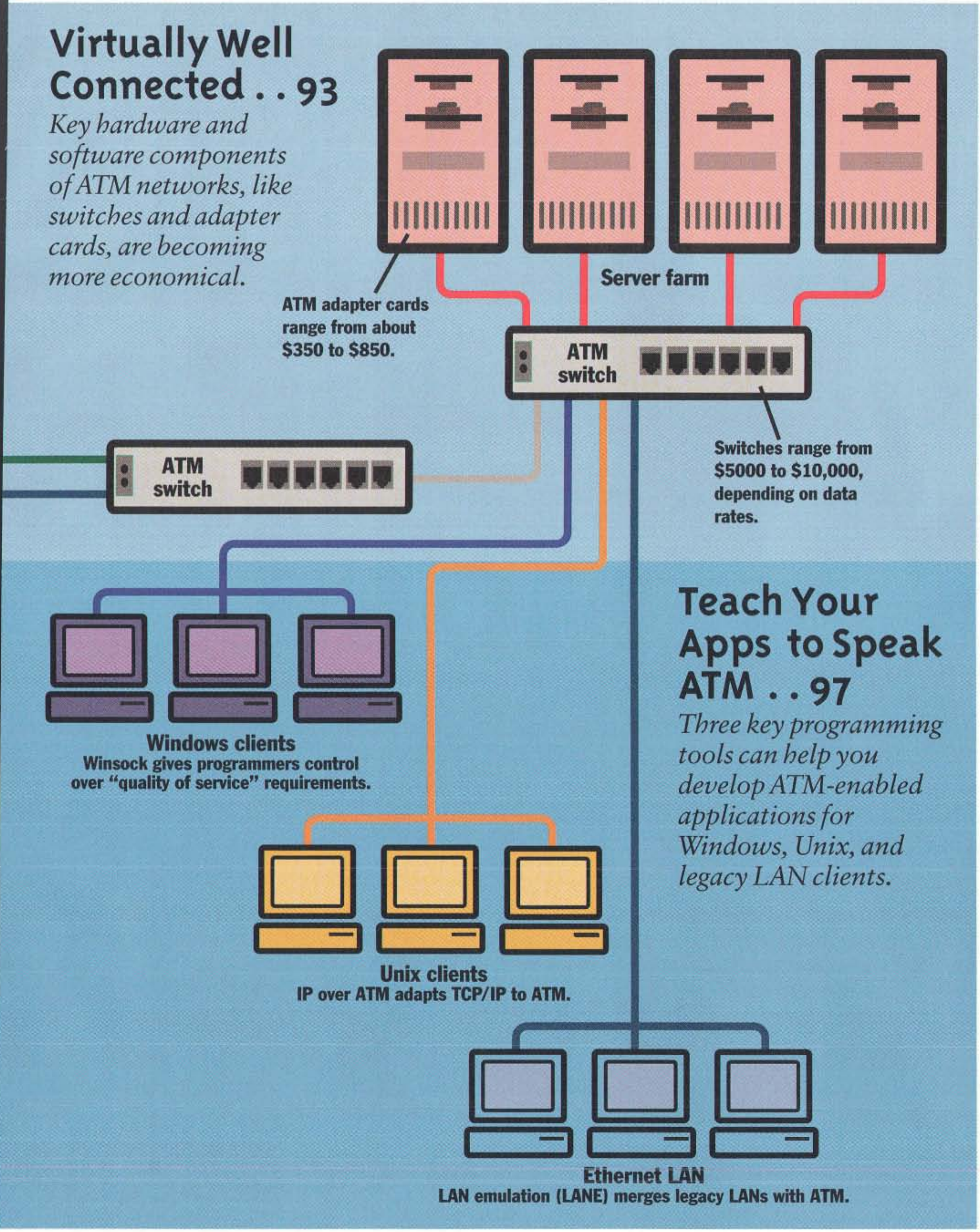
Are You Ready for ATM? . . 85

ATM can provide the infrastructure for distributed, client/server computing and connect bandwidth-hungry "power users."



Virtually Well Connected . . 93

Key hardware and software components of ATM networks, like switches and adapter cards, are becoming more economical.


Server farm
ATM adapter cards range from about $350 to $850.
ATM switch
Switches range from $5000 to $10,000, depending on data rates.
ATM switch
Windows clients
Winsock gives programmers control over "quality of service" requirements.
Unix clients
IP over ATM adapts TCP/IP to ATM.
Ethernet LAN
LAN emulation (LANE) merges legacy LANs with ATM.

Teach Your Apps to Speak ATM . . 97

Three key programming tools can help you develop ATM-enabled applications for Windows, Unix, and legacy LAN clients.

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Ease of Use	8.3	7.2
Versatility/Features	10	8.7
Compatibility	6.7	6.5
Speed of API Calls	0.9	1.2
Final Score	**8.5**	6.5

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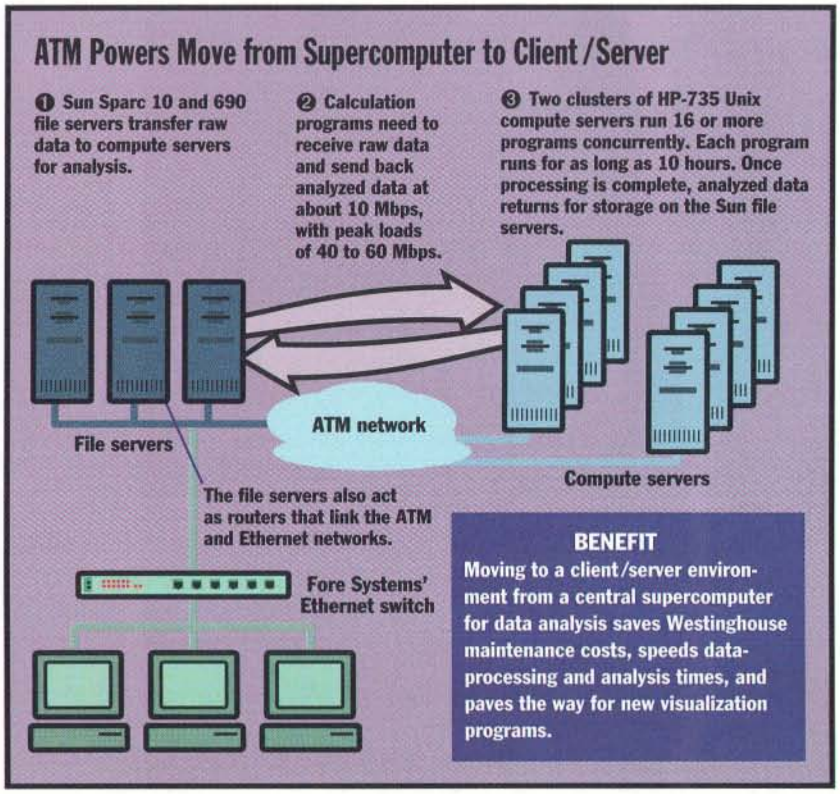
State of the Art

Pioneers are using ATM. Here are five reasons why you might want to join the pack. By Lane F. Cooper

Are You Ready for ATM?



ATM Powers Move from Supercomputer to Client/Server

❶ Sun Sparc 10 and 690 file servers transfer raw data to compute servers for analysis.

❷ Calculation programs need to receive raw data and send back analyzed data at about 10 Mbps, with peak loads of 40 to 60 Mbps.

❸ Two clusters of HP-735 Unix compute servers run 16 or more programs concurrently. Each program runs for as long as 10 hours. Once processing is complete, analyzed data returns for storage on the Sun file servers.

The file servers also act as routers that link the ATM and Ethernet networks.

BENEFIT

Moving to a client/server environment from a central supercomputer for data analysis saves Westinghouse maintenance costs, speeds data-processing and analysis times, and paves the way for new visualization programs.

ATM is a technology for today at a Westinghouse division that designs nuclear power plants.

Voice ... video ... distributed client/server computing.... Many Fortune 1000 network managers are losing sleep over how they'll handle burgeoning network traffic and gigabytes of data. Simply throwing more bandwidth at the problem isn't a total solution because not all demands on the network are equal. For instance, most e-mail and data-file transfers can cope with latency. On the other hand, multimedia applications require a guarantee of a minimum level of performance throughout a session.

Asynchronous transfer mode (ATM) promises broadband speeds that surpass 1 Gbps, as well as quality-of-service guarantees that make multimedia viable. Add to that the technology's ability to absorb different access technologies—whether it be Ethernet, frame relay, or Fiber Distributed Data Interface (FDDI)—on a single network, and you get the attention of corporate network managers.

But we've all heard the promises of ATM proponents for years. Even now that many of the initial standards issues have been resolved, ATM remains mainly a tool for telecommunications service providers to increase backbone bandwidth and pave the way for consolidating voice, data, and video onto a single network.

This leaves corporate network managers still asking, "When will ATM make *our* lives easier?"

For pioneering network administrators, the answer may be, "Now" (see the text boxes "ATM Goes Stratospheric" on page 86, and "ATM Energizes Distributed Computing" on page 88). To help large corporations implement ATM today, there will be a continuing wave of new ATM products and services for LANs and WANs this year. These products include everything from cheap 25.6-Mbps adapter cards to switches with built-in Ethernet ports for quick links to existing LANs (see "Virtually Well Connected" on page 93). Nevertheless, ATM still requires the pioneer spirit. Widespread corporate implementations of ATM probably won't happen until 1998 and later, when we will see hardware and software applications that will better integrate heterogeneous networks into new ATM infrastructures (see "Teach Your Apps to Speak ATM" on page 97). Should you be an ATM pioneer and make ATM part of your short-term plans? Or should you plan for ATM as a technology for the future? The following questions can help you find the answers for your company.

Question # 1: What can ATM offer to reduce bandwidth bottlenecks that traditional LAN technologies cannot provide?

Traditional LAN technologies primarily support store-and-forward data transfers. These technologies use connectionless routers. That is, no circuit is set up for the data exchange. Instead, the sender launches data, which finds its way to the receiver on a "best-effort" basis. Consequently, when network performance degrades because of congestion, everybody—and every application—shares the pain.

ATM is a connection-oriented technology. Because it was designed for telecommunications carriers to support voice connections, ATM can establish *virtual circuits*, which reserve dedicated amounts of bandwidth for the duration of the session. This ability guarantees that bandwidth will be available when needed, and this separates ATM from technologies like FDDI and Fast Ethernet, which also offer broadband access.

By setting aside bandwidth for discrete connections, you can use ATM to better manage the different types of traffic going over the network without overinvesting in bandwidth infrastructure. For instance, for the people within your company who are simply exchanging e-mail messages or transferring text documents (this is perhaps the majority of your traffic), network management software will let you set aside relatively small amounts of ATM's scalable bandwidth.

The remaining bandwidth then becomes available for resource-intensive applications like videoconferencing, which needs perhaps 3 Mbps for the remainder of the session. With bandwidth locked in for the video sessions in

ATM Goes Stratospheric

Major players in the petroleum industry's trade association, the American Petroleum Institute, have deployed a shared asynchronous transfer mode (ATM) network over which members can gather, process, and exchange oil-exploration data. The research project, known as ATM Research and Industrial Enterprise Study (ARIES), uses Comsat World System's ATM service, which deploys very small aperture terminals (VSATs) for high-capacity links to the Intelsat system of geosynchronous satellites.

"Gathering and processing seismographic data is a very expensive undertaking," says Susan Miller, director of advanced business applications at Comsat World Systems. "There is a tremendous amount of information that they have to get from their exploration ships and have processed at several supercomputing centers in the U.S.," she adds.

Amoco, the originator of the project, searches for oil by mapping the earth with complex seismic computer programs that generate files of gigabyte to terabyte size. This data often comes from remote sites ranging from fields in Siberia to ships at sea. Amoco must move this data from the remote sites to central data-processing sites in the U.S., including the Minnesota Supercomputer Center in Minneapolis.

Traditionally, data communications between ships at sea and processing centers have used what can only be described as the world's most expensive sneakernet. Exploration ships collect information from promising locations, transfer the data to reels of magnetic tape, and fly them via helicopter to onshore facilities for processing (see the figure below). It can take days for the data to travel over leased lines to other supercomputing centers for analysis. Because the distribution process takes so much time, exploration ships usually don't stay in the exploration area awaiting the results of the analysis and instructions on where to proceed next.

Amoco's network currently uses time-division multiplexing (TDM) technology with a mesh of T1 links that serve 400 domestic and nearly 50 international nodes. Four networks are mapped over the physical TDM network for Systems Network Architecture (SNA) traffic, voice traffic, X.25 links, and routed data traffic. Amoco's LAN environment supports TCP/IP, DECnet, and Fiber Distributed Data Interface (FDDI) for LAN backbones.

When the data arrives at the supercomputer center, Amoco's researchers in Tulsa, Houston, and suburban Chicago use the network to gain remote access to seismic modeling and simulation applications. These applications produce large volumes of output, for which ATM may well be suited.

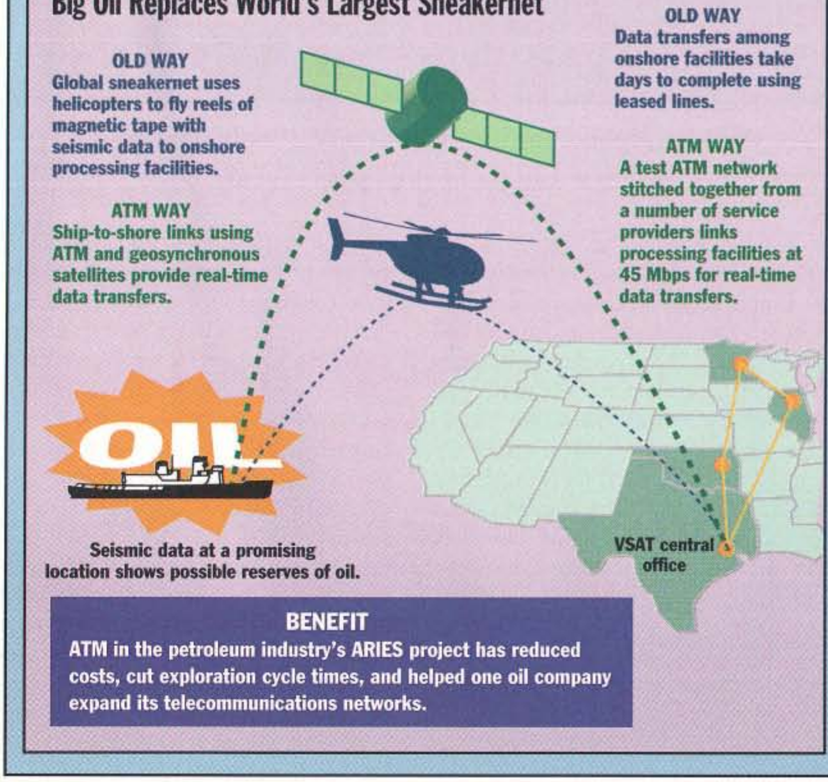
ARIES is testing terrestrial connections that link together all the project's computing facilities at 45 Mbps using an ATM network supplied by a number of service providers. Added to the land-based network is the ship-to-shore link using the Comsat ATM link accelerator to collect and distribute data in real time. "ARIES participants are having to reduce the cost of oil exploration—one of their major cost centers—by a factor of 2 to 4 times, depending on how well they can make the ATM network run.

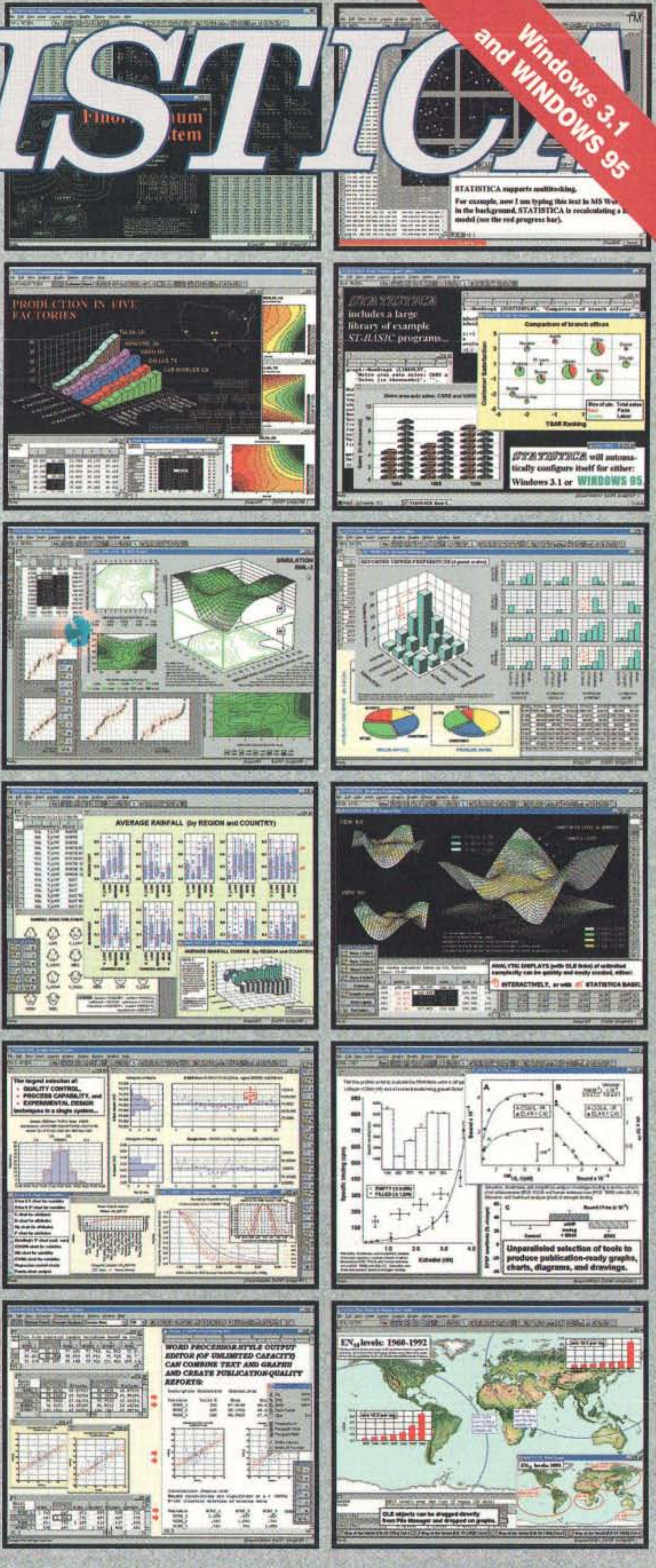
"Better communications may make it possible to reduce our cycle times dramatically for oil exploration," says David R. Beering, who is codirector of the ARIES project. "Instead of sending a crew to the field to make expensive test drills, we want to do more [work] on the computer. Doing so could increase our probability of finding oil, because we will have better information about where to drill."

In addition to reducing exploration time and the associated costs, Amoco will use the project to test ATM as a way to enhance its corporate telecommunications network. The $25 billion energy company runs operations throughout the world over an enterprise-level network that typically doubles in size every 10 months. Ethernet, token ring, Fast Ethernet, and FDDI simply aren't up to the task of handling this mushrooming data load. As a result, Amoco's telecommunications experts are evaluating ATM's ability to provide bigger data pipelines to help the company more efficiently fill its oil pipelines.

–Barry Nance and Lane F. Cooper

Big Oil Replaces World's Largest Sneakernet


OLD WAY
Global sneakernet uses helicopters to fly reels of magnetic tape with seismic data to onshore processing facilities.
ATM WAY
Ship-to-shore links using ATM and geosynchronous satellites provide real-time data transfers.
OLD WAY
Data transfers among onshore facilities take days to complete using leased lines.
ATM WAY
A test ATM network stitched together from a number of service providers links processing facilities at 45 Mbps for real-time data transfers.
OIL
Seismic data at a promising location shows possible reserves of oil.
VSAT central office
BENEFIT
ATM in the petroleum industry's ARIES project has reduced costs, cut exploration cycle times, and helped one oil company expand its telecommunications networks.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a virtual circuit, nothing that occurs on the rest of the network can degrade the quality of the connection.

Question #2: If and when we commit to ATM, how do we begin the transition from our existing network?

The best first step is to ATM-enable discrete high-performance groups within the enterprise. Thus, you might equip the LANs in resource-intensive workgroups, like engineering design or radiology, with ATM adapter cards and then bridge the souped-up LANs to the rest of the corporate network.

Question #3: During the transition process, how do we integrate the alphabet soup of platforms, protocols, and OSes we have in our legacy networks?

Downsizing, mergers, and the natural evolution of networks all mean that network managers must combine ATM with myriad technologies and protocols that were originally designed to be supported by a dedicated infrastructure.

One of the problems with integrating different protocols onto a single network is that some network technologies can obtain and use available backbone bandwidth better than others. For example, when you roll TCP/IP traffic into a trunk with IPX, it tends to effectively starve the IPX traffic of bandwidth. Since much of the current networking technology is connectionless, it is difficult to identify and assist the lower-performing protocols on the backbone. From a multiprotocol management standpoint, the challenge is to make sure everybody's traffic gets where it needs to go within predictable performance parameters.

The bandwidth guarantees associated with ATM's connection-oriented characteristics come into play here. Besides being able to set aside bandwidth for different traffic types (voice, text, or video) or applications (workgroup computing or videoconferencing), ATM's virtual circuits can guarantee that each protocol has enough access to backbone network resources to serve your work force.

How do you make sure everyone gets the resources they need? You simply define a virtual circuit for TCP/IP, IPX, DECnet, Systems Network Architecture (SNA), or any other protocol to let it coexist on the same corporate backbone.

Each protocol then has fair access to any free bandwidth that may be available on the trunk at any particular time. Most ATM switch vendors sell protocol-specific cards that you can insert into a switch on your corporate backbone and manage a multiprotocol network. Increasingly, this approach could also support voice data and help computer telephony integration (CTI) tear down the wall that exists between the telephone and data networks.

Question #4: How does ATM fit in with the mix of technologies that link remote workers to central offices?

If you're struggling to integrate workers who routinely dial in to the corporate LAN via regular voice-grade copper wires, there is some good news. The shift by public telecommunications companies from analog to digital technology means that most central office switches that are operated by the service carriers are already digital. Basic rate ISDN, which supports 64 Kbps, is more widely deployed than ever before, and newer Digital Subscriber Line (DSL) technology promises to help boost performance for telephony and data transmissions.

ATM may combine with these technologies to provide high-speed connectivity using the existing copper telecommunications infrastructure. For example, U S West earlier this year launched a trial to see if DSL can support speeds of 768 Kbps to 1.544 Mbps, or faster, using digital modems. Results aren't in yet, but the telephone line in this trial is transporting data using the new digital technology to access the carrier's ATM backbone.

continued

ATM Energizes Distributed Computing

Westinghouse Electric Corp.'s Energy Systems Business Unit (ESBU) is evaluating asynchronous transfer mode (ATM) as a way to lower the overall cost of client/server computing. The ESBU's Nuclear Technology Division, which is based in Monroeville, Pennsylvania, is an engineering services organization that helps design and maintain nuclear power plants. Until recently, it used a supercomputer to automate its computationally intense design and maintenance tasks.

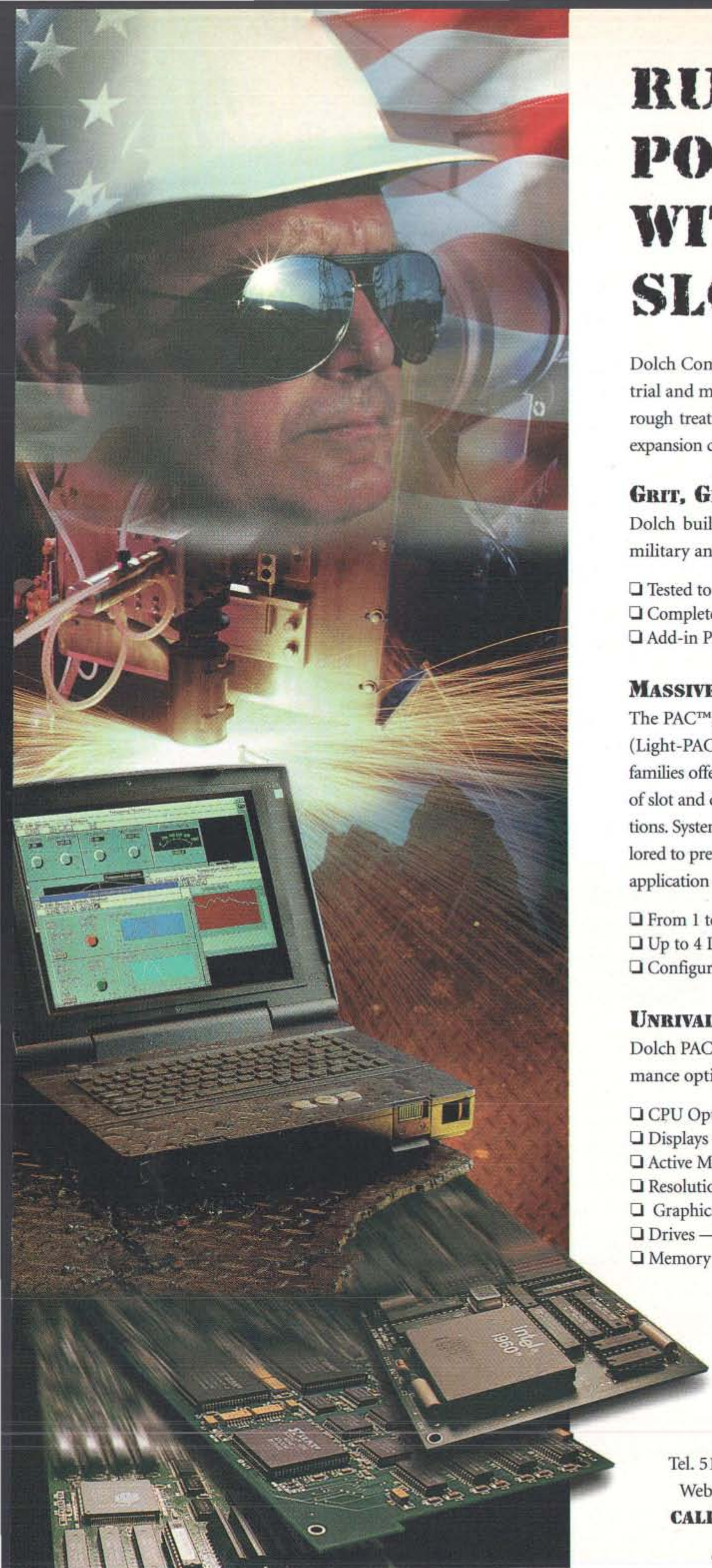
To take advantage of distributed client/server computing, Westinghouse transferred the computing tasks onto a network of Unix workstations (see the figure "ATM Powers Move from Supercomputer to Client/Server"). The company uses ATM to link the workstations because ATM could supply sufficient bandwidth to carry the gigabytes of data that the division handles. The network has several compute servers, which execute engineering software in batch mode. Each computer program runs for as long as 10 hours. The first processing step transfers many large files from file servers to the compute servers. As it finishes its calculations, hours later, each program stores larger data files (hundreds of megabytes) back on the file servers.

The resulting data traffic calls for a network capable of supporting both high average bandwidths and occasional usage peaks. Each calculation program needs to store and retrieve data at a rate of about 10 Mbps, with peak loads of 40 to 60 Mbps. Sixteen or more programs may run concurrently. The network currently consists of two clusters with four compute servers each.

The division uses both Hewlett-Packard P735 and Sun Microsystems' Sparc 10 and 690 workstations. The HP workstations act as compute servers, and the Sun Sparc workstations act as file and data servers. The Sun workstations also operate as routers that link the company's Ethernet LANs to the ATM network via Ethernet switches from Fore Systems.

The decision to move from a supercomputer environment to a distributed architecture was primarily based on cost. Maintaining and operating the supercomputer drained millions of dollars per year, an expense the company wanted to reduce without sacrificing timeliness. In addition, the distributed client/server architecture lends itself to interactive applications, a direction Westinghouse wants to take with its networked desktop computers. The batch-mode supercomputer doesn't fit into the company's plans for computing within the Nuclear Technology Division.

Today, the applications are still mostly batch-processing programs. However, the company plans to develop interactive applications using visualization software. The fast ATM network, the designers say, will be part of the batch-to-interactive software development transition because the new software will generate even more data than the old batch-mode programs did. Westinghouse expects to build database front-end software, with a graphical look and feel. Engineers will then be able to view the results visually, instead of having to interpret hard-copy numbers. **–Barry Nance**



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Companies that are attached to the broadband network can support peer-to-peer connections between remote users and the LANs, as well as pay for the use of the carrier's ATM backbone to interconnect with other LANs in the region.

The early interconnections between DSL and ATM technologies are not symmetric. In other words, there is a significant capacity difference between upstream (to the network) and downstream (to the remote PC) traffic. But there should still be plenty of bandwidth to support communications between an enterprise network and a remote location. For example, Asymmetric Digital Subscriber Line (ADSL) supports between 64 and 640 Kbps going upstream, with 1.5 to 6 Mbps going downstream.

Question #5: How can ATM tie together our international operations?

Whether your international presence is large or small, you face the challenges of keeping in touch with subsidiaries and customers that are several time zones away and perhaps in countries where only rudimentary telecommunications infrastructures exist.

One strategy is to use ATM via satellite to connect international and geographically remote operations. Beginning this September, Comsat World Systems will offer a two-tiered ATM service that will provide intermediate- and high-bandwidth services to common carriers and multinational network customers. Some of its services will use very small aperture terminals (VSATs), which are highly portable earth stations that can handle high-capacity links to the Intelsat system of geosynchronous satellites.

The integration of ATM into these VSAT networks will enable remote facilities to exchange massive amounts of multimedia information, including voice, with terrestrial networks for real-time access to corporate applications. Currently, the ATM Research and Industrial Enterprise Study (ARIES) project conducted by the American Petroleum Institute is investigating a land-and-satellite-based network that uses ATM for oil exploration (see the text box "ATM Goes Stratospheric").

Status Check

Today, large-scale ATM implementation is primarily the work of long-distance and regional carriers and Internet service providers that need a wide range of services over a single network infrastructure. If you need large amounts of bandwidth and guaranteed resources, ATM products and services will help you become a corporate pioneer. Otherwise, it may be best to wait two to four years before you start your company's network down the road to becoming ATM-enabled. **B**

Lane F. Cooper is a writer specializing in broadband-network technologies. You can reach him by sending e-mail to **lcooper404@aol.com** *or on BIX c/o* **editors@bix.com.**

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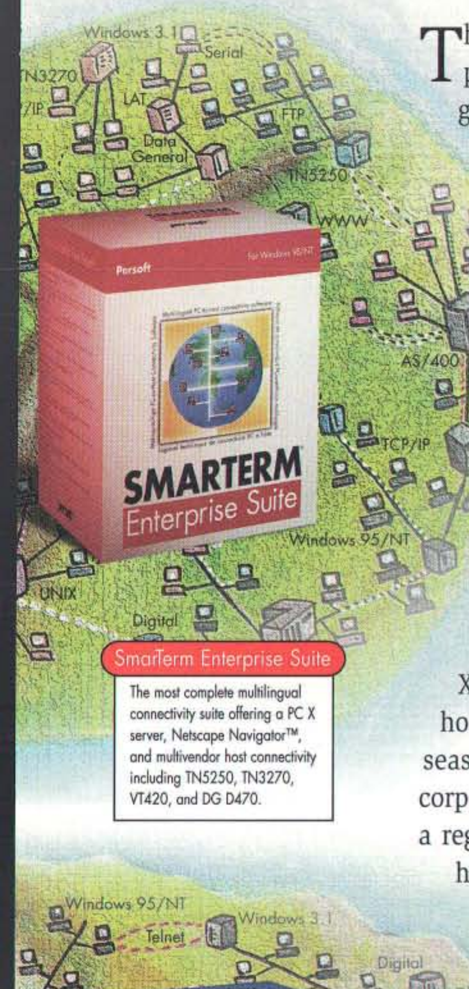

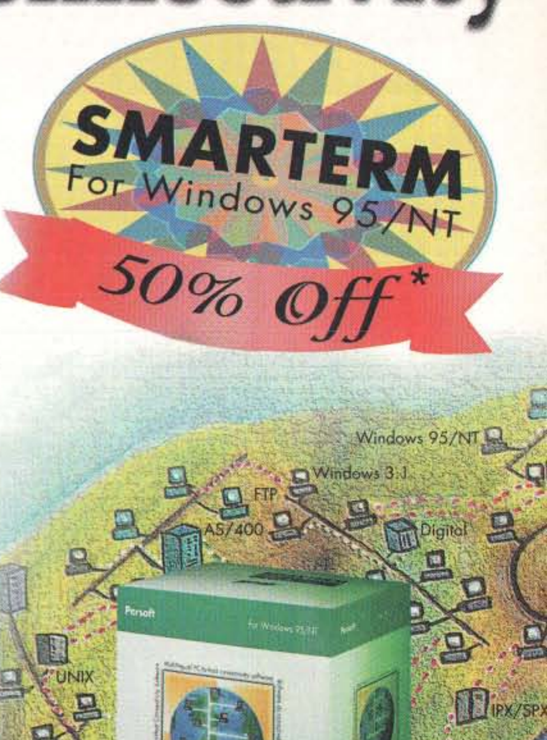

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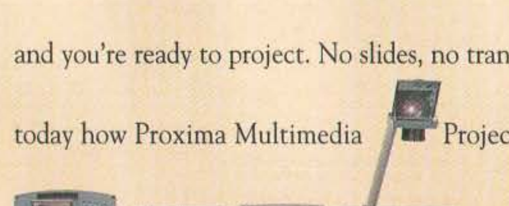

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State of the Art

Virtual circuits make ATM intriguing. Here's what to consider before implementing them. ***By Alan Joch***

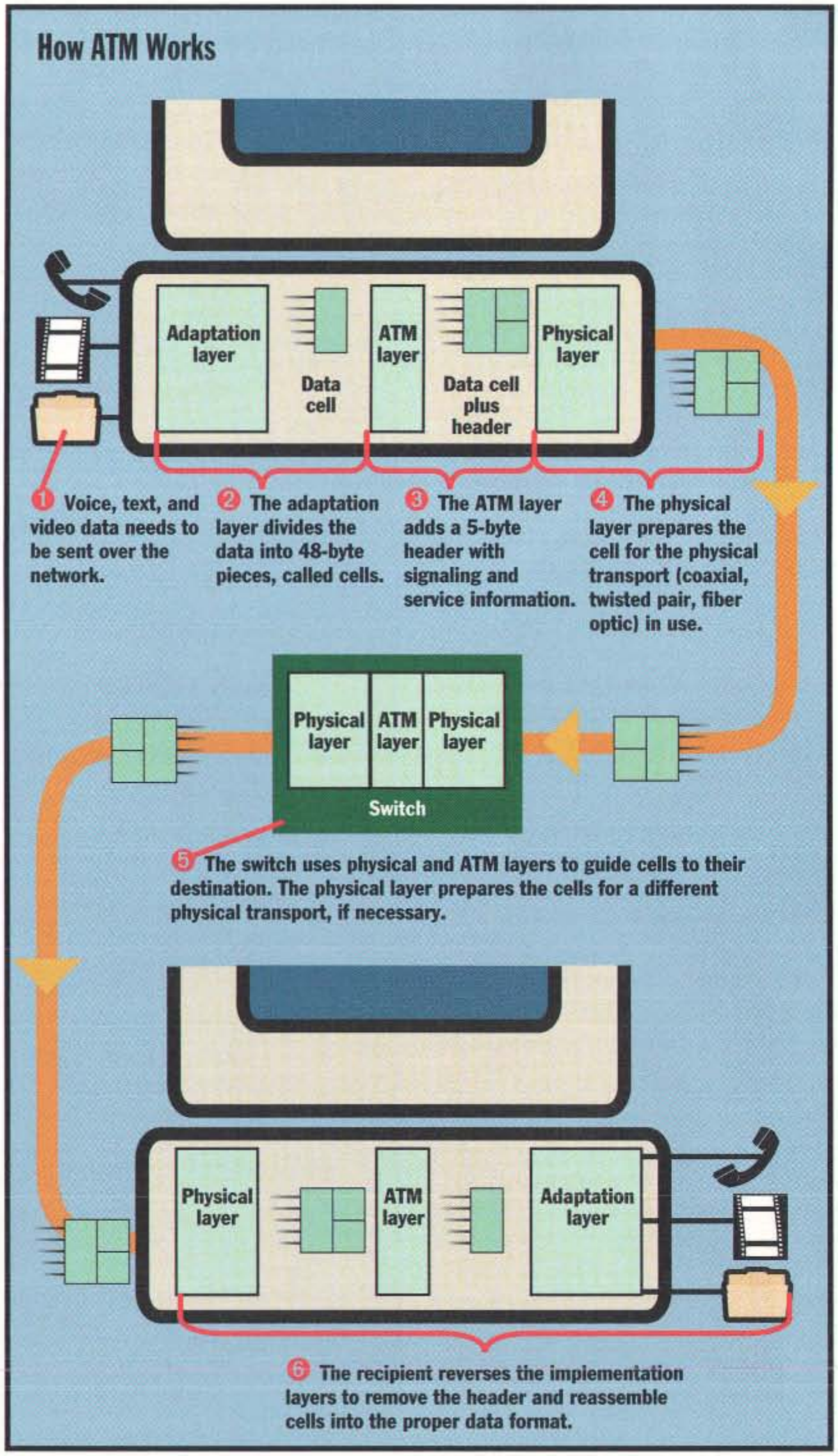
Virtually Well Connected

Connections. Boil down all the promises, technical analyses, and marketing hype surrounding asynchronous transfer mode (ATM) and that one word explains why ATM has a decent shot at replacing today's Ethernet and token-ring networks.

Connections in the ATM context mean that when you send data from your workstation to someone else's, you use an ATM switch to establish a direct link between you and the recipient. In principle, it's like making a telephone call (see the figure at right). The link, known as a virtual circuit in ATM parlance, can be a permanent connection between computers that communicate regularly, or network management software can let administrators establish a connection that lasts only as long as it takes to transmit some data.

By contrast, so-called "connectionless" networks, like Ethernet and token ring, link individual workstations to the network but not to each other. This means that when you send data to someone, you launch it onto a shared network bus—along with all the other traffic everyone else has sent out there—with instructions for where the data is supposed to go. Rather than being analogous to a telephone call, data transport over traditional LANs is more like sending a delivery truck onto an expressway.

Why is ATM and its connection-oriented approach beneficial? First, it means you can dedicate a sustained level of bandwidth to the transmission; traffic from everyone else on the network doesn't horn in to delay or interrupt your communications. This is known as "quality of service," and within the ATM specification, you can negotiate different service levels. For example, under the service level that's called *available bit rate* (ABR), the ATM network tries to provide sufficient bandwidth, but there is no guarantee that there won't be disruptions. *Constant bit rate* (CBR) is a level of


How ATM Works

❶ Voice, text, and video data needs to be sent over the network.

❷ The adaptation layer divides the data into 48-byte pieces, called cells.

❸ The ATM layer adds a 5-byte header with signaling and service information.

❹ The physical layer prepares the cell for the physical transport (coaxial, twisted pair, fiber optic) in use.

❺ The switch uses physical and ATM layers to guide cells to their destination. The physical layer prepares the cells for a different physical transport, if necessary.

❻ The recipient reverses the implementation layers to remove the header and reassemble cells into the proper data format.

service that provides a continuous and specific amount of bandwidth throughout the session. You might specify ABR when you're sending large text files, while CBR would be necessary, for example, during a videoconferencing session.

Second, ATM gives you plenty of bandwidth. The technology provides from 25.6 Mbps to 1 Gbps, which can be scaled as needed for a particular application. Third, ATM promises to be a single network technology to handle all data types—text, audio, video, and graphics—for transmission over LANs and WANs.

Stumbling Blocks

ATM proponents have been making these promises for years, but so far only telecommunications service providers have found compelling reasons to deploy the technology on a large scale. Corporations have hesitated to commit to ATM because of high costs. For example, as recently as 18 months ago, a 155-Mbps ATM adapter card cost about $1400, or roughly the price of a midrange PC. The good news is that adapter cards with the same data rate cost about $850 today, while new 25-Mbps cards offer prices below $400 in some cases.

Other rays of hope for ATM have begun to shine. Just over a year ago, the ATM Forum released the LAN emulation (LANE) specification, which standardizes how legacy LANs, like Ethernet and token ring, can communicate with ATM networks. This gives managers the ability to gradually migrate select workgroups to ATM rather than having to initiate an abrupt changeover from one network technology to another.

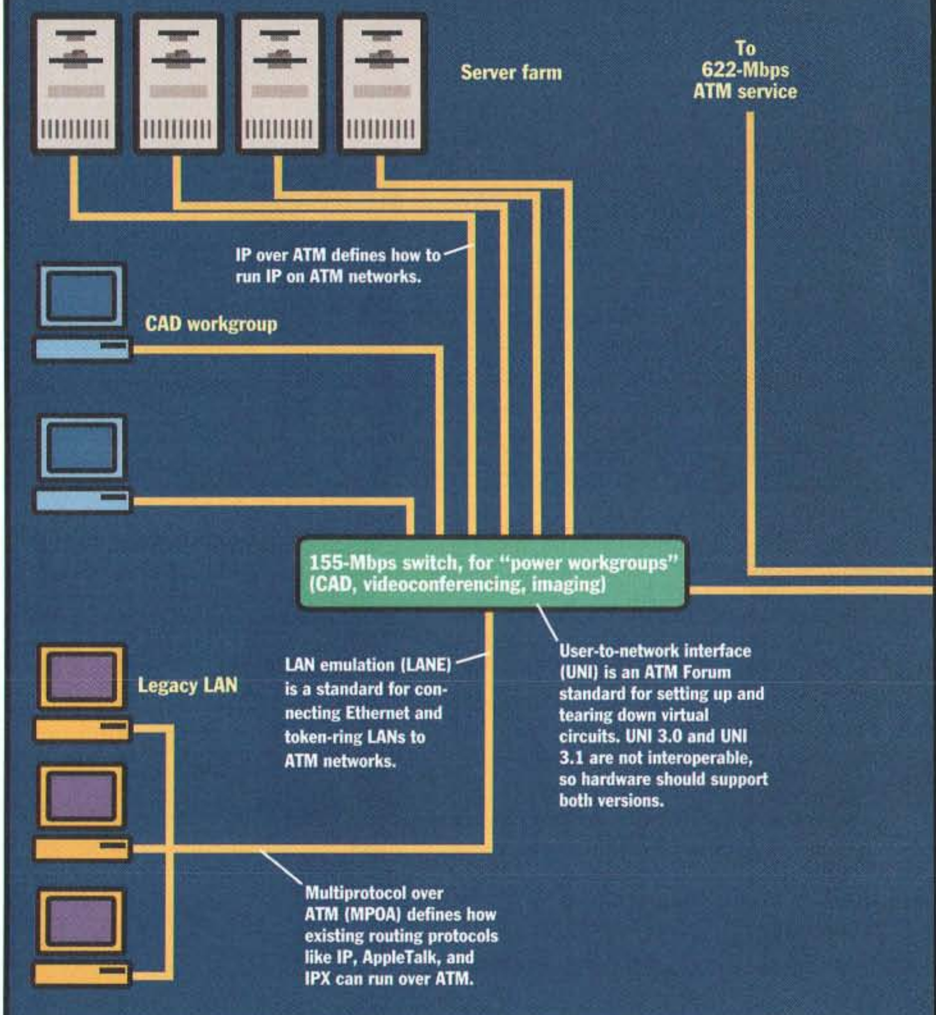
ATM implementation also hasn't had smooth sailing because designers of competing technologies haven't been napping. For example, 100VG-AnyLAN offers 10-Mbps or 100-Mbps data rates with the advantages of a switched architecture and dedicated bandwidth. Adapter cards cost as little as $200. Fast Ethernet, or 100Base-T, also offers 10 or 100 Mbps, although it uses a shared, rather than a switched, architecture, and it doesn't provide for dedicated bandwidth.

Switched Ethernet and switched token ring use the existing protocols but let administrators provide guaranteed bandwidth for multimedia and other heavy-duty applications thanks to more-sophisticated hubs. However, the switched versions of both technologies hit the same 10- and 16-Mbps bandwidth limits, respectively, as their predecessors.

What You'll Need

ATM backers counter by saying that competing technologies are just souped-up versions of legacy technologies. They may be good in the short haul, but long-term strategy argues for a new technology built from the start for high band-

Key Components


Server farm
To 622-Mbps ATM service
CAD workgroup
155-Mbps switch, for "power workgroups" (CAD, videoconferencing, imaging)
Legacy LAN

IP over ATM defines how to run IP on ATM networks.

LAN emulation (LANE) is a standard for connecting Ethernet and token-ring LANs to ATM networks.

User-to-network interface (UNI) is an ATM Forum standard for setting up and tearing down virtual circuits. UNI 3.0 and UNI 3.1 are not interoperable, so hardware should support both versions.

Multiprotocol over ATM (MPOA) defines how existing routing protocols like IP, AppleTalk, and IPX can run over ATM.

ATM Management Software

The best ATM software lets administrators easily set up, maintain, and tear down virtual circuits. ATM software also helps you remotely configure the network and monitor performance.

What to consider:

- Are switched virtual circuits and switched virtual paths supported?
- Can you create virtual workgroups?
- Can it automatically reestablish permanent and switched virtual circuits if broken?
- Does it support SNMP and management information bases (MIBs)?
- Does it work with your network management software (i.e., Openview, Netview)?
- Can you view virtual circuits graphically?
- Can you track peak traffic, average traffic, and other performance statistics?
- Does it support your client platforms?
- What quality-of-service parameters does it support?
- Manage switches from different vendors?

Representative vendors:
Cisco Systems (http://www.cisco.com)
Fore Systems (http://www.fore.com)
UB Networks (http://www.ub.com)

width, scalability, and flexibility in handling multiple types of data. Some corporations are heeding this message. As you make your move, or plan your move, to ATM, you'll need to understand some of the key components. The figure below provides some idea of things you have to consider when you start specifying ATM switches and adapter cards, as well as the management software that lets you set up, maintain, and disassemble your virtual connections. ■

---

*Alan Joch (**ajoch@bix.com**) is BYTE's senior editor/features.*

Workgroup Switches

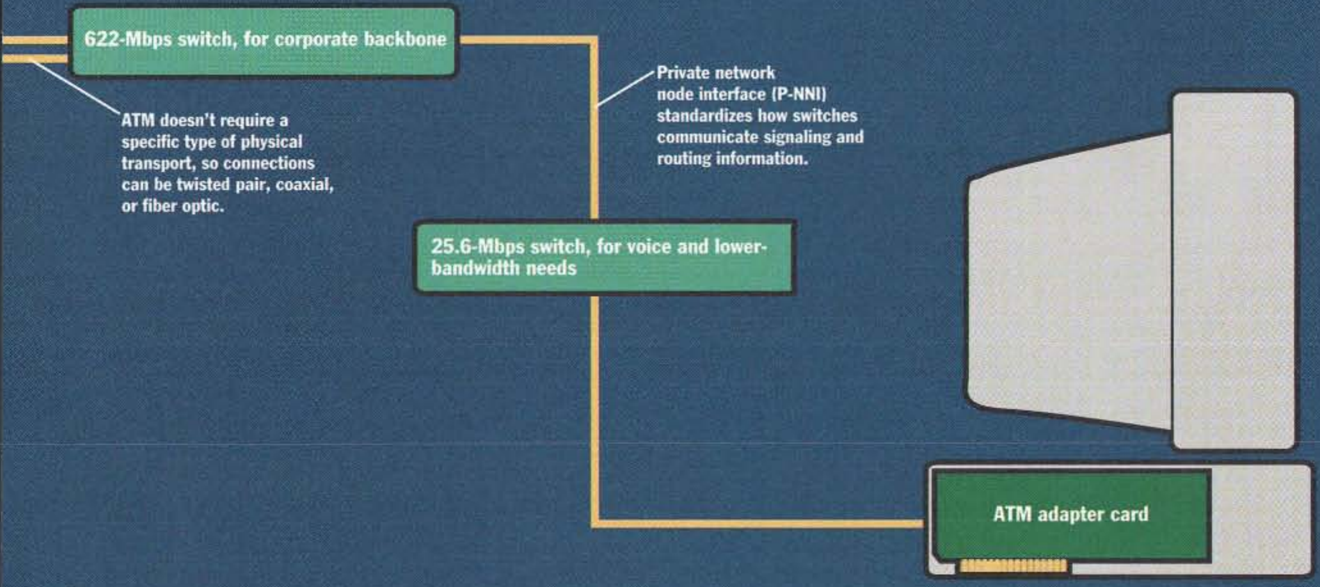
Switches are the command centers for ATM's connection-oriented approach to moving data cells along virtual circuits. Prices range from $5000 to over $10,000 depending on data rates and number of ports.

What to consider:

- Does the data rate (i.e., 622 or 155 Mbps) match your needs?
- How many ports are standard and how many more can you add as your network grows?
- How many cell buffers come standard?
- How many Ethernet or token-ring ports are standard?
- Does it support the following:
  - UNI 3.0 and UNI 3.1?
  - LAN emulation (LANE)?
  - Private network node interface (P-NNI)?
  - IP over ATM?
  - Multiprotocol over ATM (MPOA)?
- Does it support permanent and switched virtual circuits?
- Does it support SNMP and your network management software?

Representative vendors:

ATM Inc. (http://www.atminc.com)
Bay Networks (http://www.baynetworks.com)
Cisco Systems (http://www.cisco.com)
Fore Systems (http://www.fore.com)
Fujitsu (http://www.fujitsu.com)
General DataComm (http://www.gdc.com)
IBM (http://www.ibm.com)
Ipsilon Networks (http://www.ipsilon.com)
Madge Networks (http://www.madge.com)
Newbridge Networks (http://www.newbridge.com)
Olicom (http://www.olicom.com)
3Com (http://www.3com.com)
UB Networks (http://www.ub.com)
Whitetree (http://whitetree.com)


622-Mbps switch, for corporate backbone
ATM doesn't require a specific type of physical transport, so connections can be twisted pair, coaxial, or fiber optic.
Private network node interface (P-NNI) standardizes how switches communicate signaling and routing information.
25.6-Mbps switch, for voice and lower-bandwidth needs
ATM adapter card

ATM Adapter Cards

Interface cards connect workstations to the ATM network typically using unshielded twisted-pair wiring or OC-3 fiber. Prices start at about $350 for 25.6-Mbps adapters and $850 for 155-Mbps cards.

What to consider:

- Does the data rate match your application?
- What bus types are supported?
- What is the size of the buffer memory?
- Are there LEDs to show loss of signal and link integrity?
- Does it support permanent and switched virtual circuits?
- Does it support UNI 3.0 and UNI 3.1?
- Are there client drivers for Windows, NetWare, OS/2?

Representative vendors:

Adaptec (http://www.adaptec.com)
ATM Inc. (http://www.atminc.com)
Cisco Systems (http://www.cisco.com)
IBM (http://www.ibm.com)
Interphase (http://www.iphase.com)
Olicom (http://www.olicom.com)
3Com (http://www.3com.com)
Fore Systems (http://www.fore.com)
ZeitNet (http://www.zeitnet.com)

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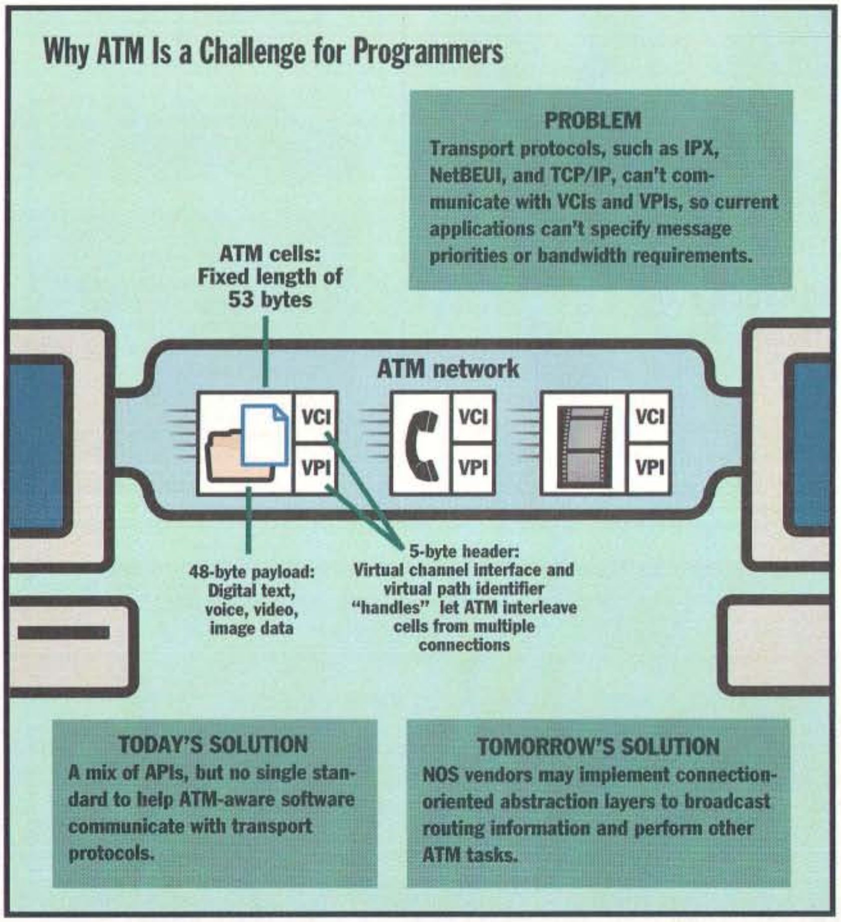
There is no single API for writing ATM-enabled software. Here are the tools you can use. *By Barry Nance*

Teach Your Apps to Speak ATM

What does it take to write software that's enabled for asynchronous transfer mode (ATM)? You have to create programs that handle time-critical data, rapidly deliver data through a network cable to other computers, and share the network cable with concurrent video and audio streams. The problems come when your application has to tell the underlying network the priority of the message or the bandwidth needed to send it. In a perfect world, a standard API would handle this task and programmers would concern themselves only with writing the application. But today's ATM world is far from perfect.

For the time being, we can't rely on any single API for every situation. The soon-to-be-released WinSock 2.0 will advance the current WinSock specification by adding ATM-specific extensions; the existing LAN Emulation (LANE) environment provides an IEEE-802 media access control–layer (MAC) interface for non-ATM-aware IPX, NetBEUI, and TCP/IP running on ATM networks; and the recently developed IP over ATM specification (outlined in RFC 1577 and RFC 1483) adapts TCP/IP for ATM networks.

Of course, you can eschew standards and marry your code to a particular hardware vendor's network adapter design—each vendor offers a proprietary interface that your software can use. But in a rapidly changing technology segment like ATM, you'd better be sure you've found true love before you tie the knot.


Why ATM Is a Challenge for Programmers
ATM cells: Fixed length of 53 bytes
ATM network
VCI
VPI
VCI
VPI
VCI
VPI
48-byte payload: Digital text, voice, video, image data
5-byte header: Virtual channel interface and virtual path identifier "handles" let ATM interleave cells from multiple connections

PROBLEM
Transport protocols, such as IPX, NetBEUI, and TCP/IP, can't communicate with VCIs and VPIs, so current applications can't specify message priorities or bandwidth requirements.

TODAY'S SOLUTION
A mix of APIs, but no single standard to help ATM-aware software communicate with transport protocols.

TOMORROW'S SOLUTION
NOS vendors may implement connection-oriented abstraction layers to broadcast routing information and perform other ATM tasks.

Programmers don't have an easy way to write applications that take advantage of ATM's connection-oriented networks.

ATM Advantages

There are a number of advantages for applications that truly speak ATM. First, programmers can write applications that mix voice, text, and video together as needed. ATM-enabled applications can run without any delays caused by concurrent network traffic. A new generation of software will use ATM to let computers share data without the pretense of mapped phantom drive letters, phantom folders, and phantom file systems.

Why do we need a new generation of software to handle ATM? Because ATM is a connection-oriented protocol that contains a connection identifier in every cell header (see the figure "Why ATM Is a Challenge for Programmers" above). ATM establishes a link between two computers to transfer data. Traditional networks, including Ethernet, are connectionless: Systems communicate over a network bus rather than via direct connections. The connection identifier explicitly associates a cell with a given virtual channel on a physical link. The connection identifier consists of two subfields, the virtual channel identifier (VCI) and the virtual path identifier (VPI). The VCI and VPI allow ATM hardware to multiplex, demultiplex, and switch cells throughout a network. VCIs and VPIs are connection handles, not addresses. ATM assigns them at each segment (the link between ATM nodes) when an application creates a connection, and the VCI and VPI exist for the duration of the connection. ATM can asynchronously interleave (multiplex) cells from multiple connections by keeping track of VCIs and VPIs.

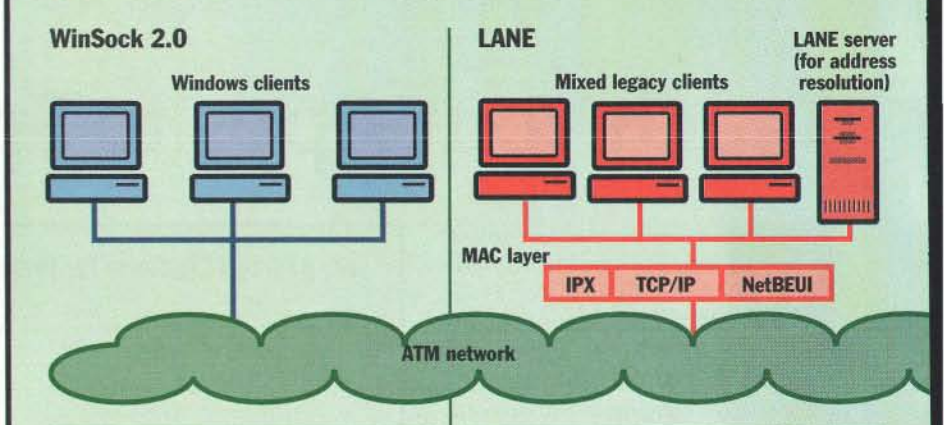
continued

At present, transport protocols such as IPX, NetBEUI, and TCP/IP and their APIs do not understand VCIs and VPIs. Applications have no way to tell the underlying network the priority of the message or the bandwidth needed to send it. Network-operating-system (NOS) vendors are working on these issues. Both Microsoft and Novell have announced plans for connection-oriented abstraction layers that are likely to broadcast routing information and service advertising packets more frugally over ATM and to optimize packet sizes for ATM's cell-oriented architecture. Both efforts should make ATM-aware programming easier in the future. Until then, WinSock 2.0, LANE, and IP over ATM are the best choices.

WinSock 2.0

Microsoft and Intel codeveloped WinSock 2.0, the new 32-bit edition of the popular WinSock interface. For compatibility with version 1.1, WinSock 2.0 includes the standard WinSock calls that let you create communications links, send

API Choices



WinSock 2.0

PROS:

- Easy to use for Win32 clients.
- Gives programmers control over transmission characteristics like quality of service.
- Protocol-independent multicast and multipoint messaging.

CONS:

- Final specification still evolving.

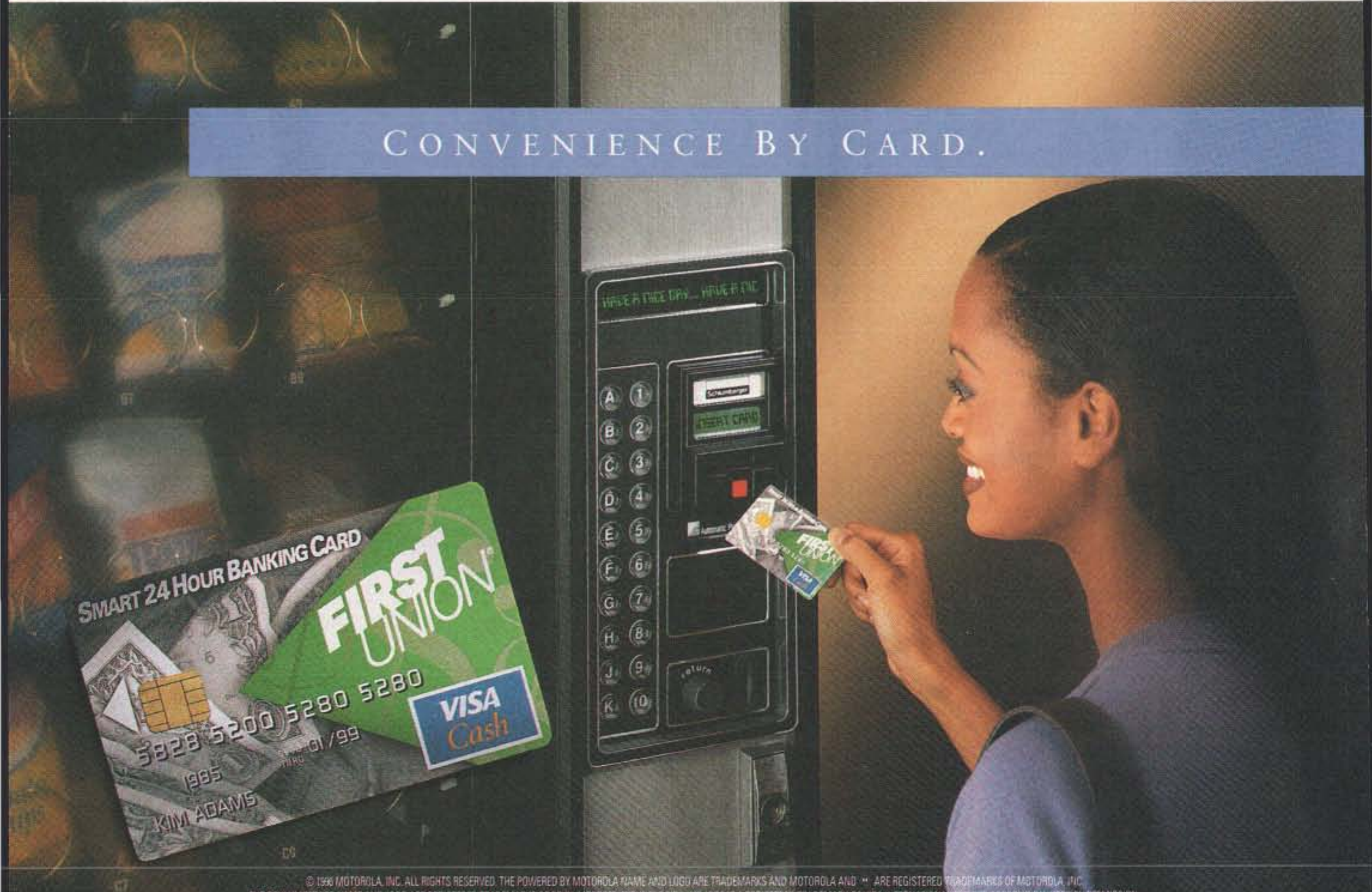
LANE

PROS:

- Lets programmers use existing drivers and protocols in ATM networks.
- Easy to program.
- Specification is finished and has been available for more than a year.

CONS:

- MAC layer can degrade performance.



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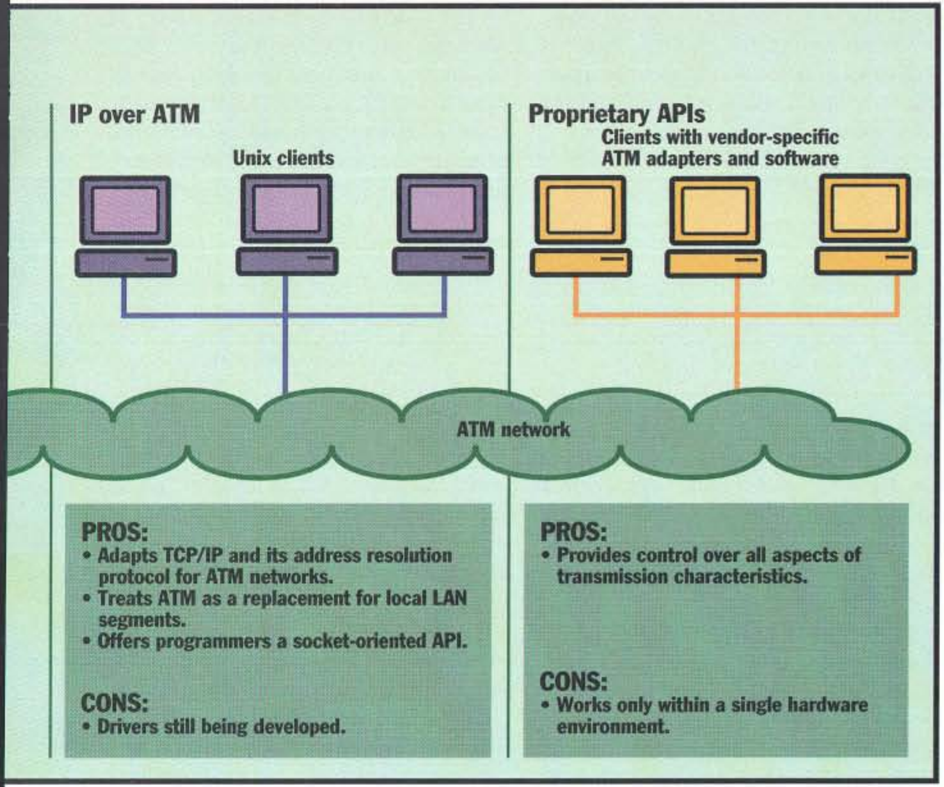

PROS:
- Adapts TCP/IP and its address resolution protocol for ATM networks.
- Treats ATM as a replacement for local LAN segments.
- Offers programmers a socket-oriented API.

CONS:
- Drivers still being developed.

PROS:
- Provides control over all aspects of transmission characteristics.

CONS:
- Works only within a single hardware environment.

and receive data over those links, and take down the links at the end of a session. To support ATM, WinSock 2.0 accommodates quality of service, which lets applications negotiate required service levels for bandwidth and latency as well as use socket grouping and prioritization. Version 2.0 also permits protocol-independent multicast and multipoint message transmission.

In WinSock 2, the `bind()` and `WSPBind()` functions use a `sockaddr_atm` data structure to register a Service Access Point (SAP). A SAP is a software connection point that behaves in many ways like a socket. The data structure contains information about incoming connection requests. SAP registration lets WinSock match an incoming connection request SAP to the SAP of a listening socket. For point-to-point connections, the `sockaddr_atm` data structure also lets you specify the destination SAP for calls your program makes to the `connect()`, `WSAConnect()`, and `WSPConnect()` functions. For point-to-multipoint connections, you use the same data structure in

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calls to `WSAJoinLeaf()` and `WSPJoinLeaf()`. The WinSock 2 specification natively supports ATM point-to-point and point-to-multipoint connection setup and teardown.

To handle ATM, WinSock 2 introduces the notion of a socket group as a means for an application (or cooperating set of applications) to tell an underlying service provider (i.e., a dynamic library or device driver) that all sockets in a particular set are related and that the resulting socket group has certain common ATM attributes. These ATM attributes include relative priorities of the individual sockets within the group, as well as a group quality of service specification. For example, applications running on different ATM nodes that want to exchange streams of multimedia data can give an audio stream a higher priority than a video stream.

You use the `WSASocket()` and `WSAAccept()` functions to explicitly create or join a socket group, and you can use `getsockopt()` to retrieve socket-group IDs.

WinSock is a relatively easy specification for programming. However, we probably won't see a final specification until early next year. Even then, WinSock will work only for Windows, so if cross-platform applications are important for you, you need to find another API.

LAN Emulation

While WinSock 2.0 offers a new ATM-aware API, LANE focuses on making existing applications run on ATM. LANE is particularly suited for helping ATM act as a LAN backbone for Ethernet or token-ring hubs, bridges, switching hubs, and routers. LANE specifies ways for LAN traffic to flow between client computers and an ATM-attached file server without the need for a separate router. To do this, the specification hides ATM from the LAN nodes, so that each client and server uses a non-ATM-specific protocol stack.

LANE doesn't replace routers or routing: It provides a complementary MAC-level service. This service works with the MAC-layer switching that occurs in the hubs and wire closets of large LANs. The MAC-layer service also provides interoperability between current applications and ATM networks. It also lets you use existing drivers and popular LAN communications protocol APIs, such as NetBIOS, TCP/IP, and IPX. However, LANE does not take advantage of ATM's potential to provide particular connections with a higher quality of service.

The specification describes how ATM can take on the appearance of a legacy physical layer medium, such as Ethernet or token ring, by providing a layer of software that translates, for example, among your program's NetBIOS calls, or your program's IPX calls, and the underlying ATM network.

LANE defines the way the three primary characteristics of IEEE-802 LANs (connectionless transmissions, broadcast/multicast messages, and hard-wired MAC addresses) work over ATM networks, which are connection-oriented, use point-to-point messaging, and have network-defined telephone-number-like addresses. An address-resolution protocol within LANE discovers the ATM address corresponding to a given MAC station address (whether the station is

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ATM-attached directly or connected via Ethernet/token ring) and constructs a virtual circuit between the end points. For broadcast and multicast IEEE-802 packets to travel over the network, a LANE server uses point-to-point circuits inbound and point-to-multipoint circuits outbound to direct the traffic. The LANE specification details the packet formats and packet encapsulations necessary for ATM to pretend to be some other physical layer, and it defines how an ATM adapter in a host can present an Ethernet or token-ring logical interface to the protocol stack in that host.

LANE can slow down your communications links because it's an extra insulating layer of software, but existing IPX, NetBIOS, and TCP/IP programming techniques work with LANE, and it is readily available.

IP over ATM

Based on work by the Internet Engineering Task Force (IETF) and others, two recent RFCs have helped IP become ATM-aware. The specification defines how to put IP packets and ARP requests directly into protocol data units and convert them to ATM cells. This is necessary because IP does not recognize conventional MAC-layer protocols, such as those that are generated on an Ethernet LAN.

RFC 1483 defines the encapsulation of IP datagrams, while RFC 1577 specifies how IP-oriented address resolution works on ATM. Both standards treat ATM as a direct replacement for the local LAN segments that connect IP nodes and routers in a non-ATM IP-based LAN. In its discussion of address resolution, RFC 1577 defines an ATM-oriented protocol for logical IP subnets (LISes). Within a LIS, IP addresses map directly into ATM Forum's (Foster City, CA) UNI 3.0 addresses.

From a programming point of view, you'll interface to IP over ATM with a socket-oriented API similar to the version 1.1 set of standard WinSock function calls. These calls let you open sockets to establish TCP/IP communications links, send and receive messages across those links, and tear down the links when you're finished.

IP over ATM makes better use than LANE of larger packet sizes and handles unicast traffic more efficiently. However, IP multicast traffic will likely require tunneling over ATM (i.e., encapsulation of multicast packets inside broadcast messages), which might make IP over ATM less efficient than LANE.

Vendors are currently developing drivers for IP over ATM, which means you won't be able to use it right away. When it's available, IP over ATM will be as easy for programmers to use as WinSock.

Three Choices

Once you've made your API selection, there's one more issue you need to address: ATM is new enough that you'll also need to make sure your hardware manufacturer can supply the drivers for your chosen approach. ATM programming isn't perfect, but these technologies are steps in the right direction. **B**

Barry Nance is a BYTE consulting editor and has been a programmer for 25 years. You can reach him at **barryn@bix.com**.

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12 Tape Libraries for Network Backup

We test data storehouses that feature at least one tape drive, gigabytes of storage space, and more.

By Jim Kane, Dorothy Hudson, and Maggi Bender

Anyone who's gazed into the shell-shocked eyes of an overworked network administrator can see that LAN gurus need more than two hands to get the job done. It's always one disaster after another: Either the network needs to be resurrected from the dead or some neophyte user can't figure out how to access e-mail. On top of the daily emergencies is the omnipresent need to back up the network on a regular basis. The 12 tape libraries we tested provide some salvation from this time-consuming task by automating network backup.

We tested two 8-mm tape libraries, three digital-linear-tape (DLT) units, and seven 4-mm tape auto-loaders that have at least one tape drive, a magazine to hold the tapes, and the robotics (usually a jukebox setup) to move the tape between the magazine and a drive. Once you set up the tape library and install the tape-inventory software, the network administrator sets a backup schedule and simply changes the magazine once per week or month. Without one of these devices, you have to manually swap tapes during backups.

Our roundup includes a hodgepodge of units that range from Seagate's internal 4586 NP ($2471) to ADIC's Scalar 458 2000XT ($50,995 as tested), which is a DLT-based tape library housed in a waist-high cabinet that can back up 4 TB of data. The DLT libraries offer the most capacity per cartridge. These cartridges provide an uncompressed capacity of about 10 GB, compared to about 4 GB for the 4-mm tape drives and about 5 GB for the 8-mm helical-scan tape drives. The higher-end tape auto-loaders have multiple drives; this provides such benefits as concurrent operations, fault tolerance, and increased throughput.

To evaluate these products, we ran tests (see "Test Specs" on page 109) that measure how fast each tape library could back up and restore 920 MB of data spread out through a file-directory tree. We also checked the tape libraries for usability and features, and then we picked winners in each technology category. We didn't examine server-backup software, but we list what applications the tape libraries support in the features table on page 110.

BYTE BEST

TAPE LIBRARIES

Exabyte 218 4mm Tape Library takes the lead with its ability to back up multiserver networks.

Exabyte 210 8mm Tape Library wins with the best performance, features, and ease of use.

Overland Data DLT Library Xpress/LXB 2210 Base Module comes out on top with its 300-GB capacity and fast backup and restore times.

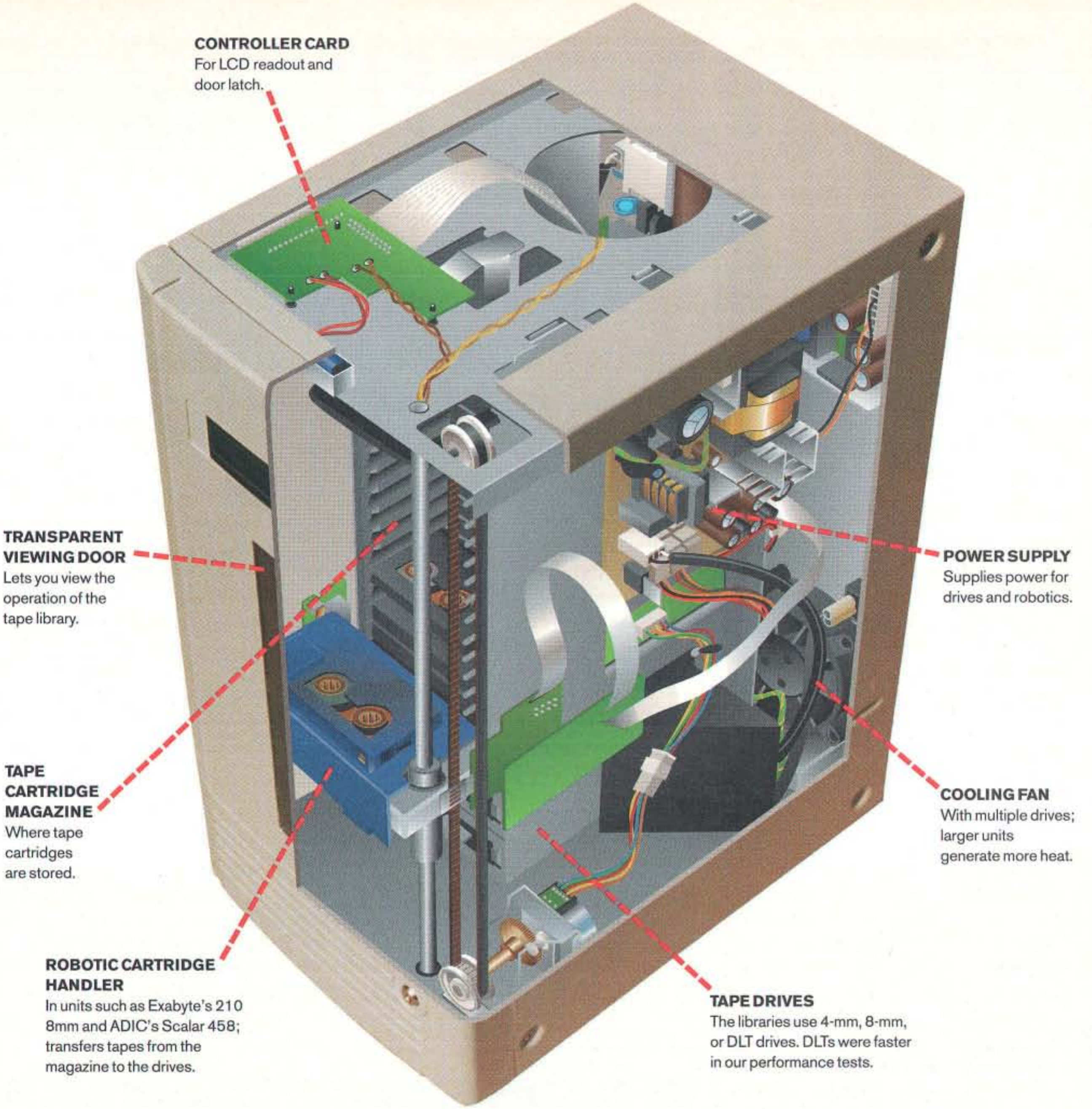
4-mm (DAT) Libraries

The seven 4-mm drives that we tested (sometimes called DAT because of Hitachi's original DAT format) are standardizing on the DDS-2 (digital data storage) format for the tiny tape cartridges. This format was developed to let data transfers occur in SCSI-2 burst mode. DDS-2 doubles the density of the previous DDS format for 8 GB of storage on a 120-meter tape, but it maintains full DDS functionality and ensures full backward compatibility to the DDS and DAT 4-mm tape formats.

Four of the higher-end DAT tape libraries that we tested are in the $8000 to $11,000 price range—Aiwa's AL-D220 AutoLoader ($7995), ADIC's VLS (Virtual Library System) 4mm ($9295), the DATa-ray 32 from Storage Solutions, Inc. (SSI; $9995), and the Exabyte 218 4mm Tape Library ($11,500)—and have multiple tape drives for reading multiple cartridges. This multitasking capability is important when you consider that, in theory, SSI's DATa-ray 32 could significantly reduce backup times if all five DAT drives were moving data at the same time. The Aiwa, ADIC, and Exabyte products have two tape drives each.

The Aiwa AL-D220 supports 17 4-mm tape cartridges in an upright chassis for 136 GB of data with 2:1 data compression enabled. The Exabyte 218 4mm Tape Library is a stand-alone unit that supports 19 4-mm cartridges for 152 GB of compressed storage. As its name implies, the SSI DATa-ray 32 can store 40 GB of data and offers excellent expandability, thanks to its stackable design. ADIC's VLS 4mm is a desktop device that can hold 15 cartridges for 120 GB of data; a robotic cartridge handler slides on a track in front of the tape magazine to enable you to move the cartridges back and forth to the tape drives.

The three remaining 4-mm tape libraries are single-drive units that provide back-



CONTROLLER CARD
For LCD readout and door latch.

TRANSPARENT VIEWING DOOR
Lets you view the operation of the tape library.

TAPE CARTRIDGE MAGAZINE
Where tape cartridges are stored.

ROBOTIC CARTRIDGE HANDLER
In units such as Exabyte's 210 8mm and ADIC's Scalar 458; transfers tapes from the magazine to the drives.

POWER SUPPLY
Supplies power for drives and robotics.

COOLING FAN
With multiple drives; larger units generate more heat.

TAPE DRIVES
The libraries use 4-mm, 8-mm, or DLT drives. DLTs were faster in our performance tests.

ILLUSTRATION: SANDERS / TIKKANEN DESIGN & ILLUSTRATION © 1996

up on a much smaller scale. Hewlett-Packard's SureStore 12000e ($3510), Micro Design International's SCSI Express 2000DC ($3595), and Seagate's 4586 NP are no bigger than a shoebox. The Seagate 4586 NP (formerly a Conner product) is so small that it fits inside a PC, but it still backs up 96 GB of data.

DLT and 8-mm Libraries

DLT is gaining market share in the LAN segment of the industry because it offers higher capacities and is faster than the 4- and 8-mm tape libraries. In contrast to helical-scan technologies, DLT drives' serpentine recording method places data in longitudinal tracks. As a result, the drives can read and record multiple channels of data simultaneously. The tapes also supposedly have a 30-year shelf life, which matches that of magneto-optical storage.

Quantum's DLT 2500XT ($4995) is a single-drive tape library with a five-cartridge magazine that you slide into the front panel for 150 GB of backup with 2:1 compression. It's the lowest-priced DLT tape library we tested. Overland Data's DLT Library Xpress/LXB 2210 ($15,495) offers 300 GB of backup in a rack-mountable case with a front-loading tape magazine. ADIC's Scalar 458 2000XT is the big daddy of all the tape libraries; it supports about 4 TB of data when its 48 cartridge bays are maxed out.

The Exabyte 210 8mm Tape Library ($13,325) and the Qualstar TLS-4220 ($12,500) have dual 8-mm Exabyte-manufactured tape drives. The Exabyte 210 8mm can hold 11 cartridges in its snap-in magazine, for 154 GB of compressed data storage. Qualstar's TLS-4220 supports two 10-cartridge magazines, for 280 GB of stored data.

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Dorothy Hudson, Project Manager/NSTL
John McDonough, Technical Writer/NSTL
Maggi Bender, Technical Analyst/NSTL
Susan Colwell, Technical Editor/BYTE

Best Overall

TAPE LIBRARIES

It's hard to pick one tape library as best overall—DLT, 4-mm, and 8-mm units have different recording formats and serve different needs. With this in mind, we broke down our winners into the best DLT, 4-mm, and 8-mm tape libraries so that we could compare the units on an even playing field.

4-mm Choices

The Exabyte 218 4mm Tape Library, our best-overall 4-mm choice (see "Lab Results" on page 105), dispels the commonly held belief that 4-mm tape libraries are merely entry-level backup solutions. With its voluminous 152-GB storage capacity, this dual-drive-configured tape auto-loader can back up multiserver networks.

The tape library rated closest to the Exabyte unit in this category is ADIC's VLS 4mm, a dual-drive desktop system with a 120-GB data capacity. This dual-drive capacity lets you retrieve files on one drive while backups are running on the other drive. The VLS 4mm received one of the highest usability ratings because its removable, 15-cartridge FastPort magazine is easy to load and unload; it has a clear and concise user's manual; and its status indicators are easy to understand.

HP's SureStore 12000e and Micro Design International's SCSI Express 2000DC are two strong, compact DAT tape libraries with 48-GB capacities. They both have HP-manufactured drives and thus have similar performance numbers. They are supported by leading network-backup applications vendors, such as Cheyenne Software and Seagate Software (formerly Arcada and Palindrome). The only inconvenience with these smaller drives is that you can't see if a tape is stuck inside the loader; however, the HP tape library has an informative LCD panel that keeps you abreast of what's going on.

DLT Choices

The DLT market is really heating up. Currently DLT tape drives account for about 7 percent of the tape-library market, but industry analysts predict that number will surge to 26 percent by the turn of the century. HP, one of the market leaders in DAT tape storage, recently threw its hat into the DLT arena and offered its first DLT-based products. Unfortunately, however, we didn't receive a product in time for this roundup. It looks like DLT is a technology worth keeping an eye on.

Overland Data's DLT Library Xpress/LXB 2210 is our best-overall choice among the DLT tape libraries because of its strong features and ease of use. Like Overland's unit, Quantum's DLT 2500XT and ADIC's Scalar 458 2000XT use Quantum-manufactured drives that afford the best performance among the three media types we tested. Because these DLT tape libraries have similar performance numbers, the choice comes down to how much network data you need to back up.

The ADIC Scalar 458 2000XT ($50,995) is the most expensive tape library that we tested, but it has four tape drives and offers the greatest capacity, with almost 4 TB of total storage in its huge 58-cartridge cabinet. At $4995, the Quantum DLT 2500XT is a much more modestly priced mini-library, with five cartridges for 150 GB of backup. Quantum's desktop device uses an elevator mechanism to provide cartridge access between the tape drive and the cartridge magazine, while the other DLT drives use robotic cartridge handlers.

8-mm Choices

The two 8-mm tape libraries in our roundup are huge, freestanding units that support enterprise-wide backup needs. Both use Exabyte-manufactured tape drives, so their performance in our backup and restore benchmarks were almost identical. The Exabyte 210 8mm Tape Library ($13,325) came out slightly ahead of Qualstar's TLS-4220 because of its higher usability and features scores.

However, the Qualstar TLS-4220 ($12,500) has several advantages over Exabyte's product in a head-to-head comparison. The TLS-4220 holds 20 cartridges, compared to 11 cartridges for Exabyte's 210 8mm. The TLS-4220 also offers great expandability options. It's only the third member of Qualstar's wide-ranging TLS-4000 product family. Therefore, if your data-storage needs expand, you can upgrade to Qualstar's TLS-46120, a monster of a tape library that has six drives and 120 cartridges, for over 1.6 TB of backup. The TLS-4220 has an intuitive control panel, and you can lock the cartridges inside the case for data security.

TAPE TECHNOLOGIES AT A GLANCE

DLT

- One of the hottest technologies in the tape-backup industry.
- 40-GB-per-cartridge compressed capacity.
- Serpentine recording technique places data in longitudinal tracks for high-speed backup and restore performance.
- 30-year shelf life is ideal for archiving data.

4 mm

- An older helical-scan technology, where tape is laid down in angles.
- Smallest form factor of the three technologies.
- Native capacities of 2 GB or 4 GB.
- The latest DDS-2 format provides double density.
- Stores 8 GB of data on a 120-meter tape.
- Not as fast as DLT but offers exceptional cost per megabyte.

8 mm

- Another helical-scan technology that offers an excellent price/performance ratio.
- 8-GB native capacity and 16 GB with 2:1 compression.
- Offers performance similar to that of 4-mm drives.
- Technology will get a performance/capacity boost when Exabyte's 40-GB, 6-MBps Mammoth tape drives filter to OEMs.

LAB RESULTS

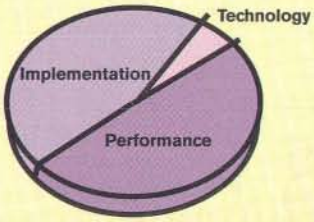
TAPE LIBRARIES RATINGS

BEST OVERALL–4-MM

Exabyte 218 4mm Tape Library

The Exabyte 218 4mm Tape Library ($11,500) ably performs automated backup and restore functions, file migration, and archival storage for networks. It's one of the few 4-mm units that has dual drives, which raises its price but adds fault tolerance and concurrent operations (i.e., it can perform reads and writes at the same time). You can add an optional bar-code reader ($1150) to help you keep track of and quickly retrieve the 152 GB of DDS-2 backup in the unit's 19-cartridge magazine library.

WEIGHTING



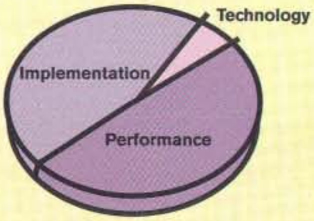
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Exabyte 218 4mm Tape Library	**$11,500**	★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Hewlett-Packard SureStore 12000e	$3510	★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
ADIC VLS (Virtual Library System) 4mm	$9295	★★★	★★★★	★★★★★	★★★	★★★★	★★★★
Micro Design SCSI Express 2000DC	$3595	★★★	★★★★	★★★★★	★★★★	★★★	★★★★
Aiwa AL-D220 AutoLoader	$7995	★★★	★★★	★★★	★★★★	★★★	★★★
Seagate 4586 NP	$2471	★★★	★★★	★★★	★★★	★★★★	★★★
Storage Solutions DATa-ray 32	$9995	★★★	★★★	★★★★	★★★	★★★	★★★

BEST OVERALL–8-MM

Exabyte 210 8mm Tape Library

Exabyte's 210 8mm Tape Library ($13,325) uses two Exabyte EXB-8505 XL drives and moves 11 8-mm cartridges containing 154 GB of backup with a robotics cartridge handler. This provides easy-to-manage automated backup for large networks and midrange systems. The SCSI-2 tape library offers easy front access with its stand-alone desktop cabinet, as well as keylock security. Exabyte bundles excellent documentation with the tape library, which earned a high usability score because it's easy to snap the tape-cartridge magazine in and out.

WEIGHTING



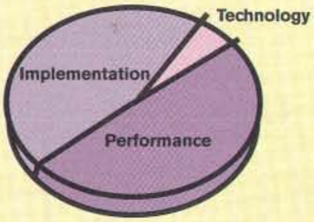
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Exabyte 210 8mm Tape Library	**$13,325**	★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Qualstar TLS-4220	$12,500	★★★	★★★★	★★★★★	★★★	★★★★	★★★★

BEST OVERALL–DLT

Overland Data DLT Library Xpress/ LXB 2210 Base Module

DLT tape libraries are becoming a hot spot among tape backup solutions because they provide high-speed, high-capacity, high-reliability backup. Overland Data's dual-drive DLT Library Xpress/LXB 2210 ($15,495) is no exception, with its 300-GB backup capacity and fast backup and restore times. The tape library affords wide flexibility for customizing tape backup solutions because it supports a wide range of network OS (NOS) platforms and third-party backup applications.

WEIGHTING



	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Overland Data DLT Library Xpress/ LXB 2210 Base Module	**$15,495**	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★
ADIC Scalar 458 2000XT	$50,995	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Quantum DLT 2500XT	$4995	★★★★	★★★★	★★★★★	★★★	★★★★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

PHOTOGRAPHS: STEVE BELKOWITZ © 1996

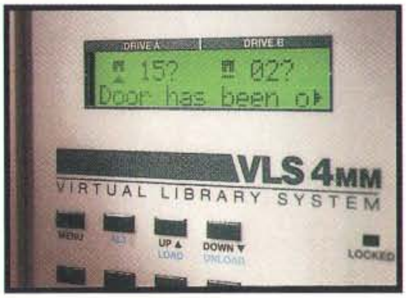
Details

Scanning Reduces Tape-Access Time

Several of the tape libraries (e.g., ADIC Scalar 458, Exabyte 210 and 218, Overland Data DLT, and Qualstar TLS-4220) we reviewed have standard or optional bar-code scanners that make it easier to keep tabs on your tape cartridges. These scanners read labels that you stick onto the data cartridges, and the tape's content is recorded in your software-library application's inventory. When it comes time to grab a cartridge to restore data, the tape auto-loader can recognize it in seconds, which is much better than having to read all the labels to find the right cartridge.

LED Status: Too Small

We might be nitpicking here, but the ADIC VLS 4mm's tiny strip of an LED is so small that you can't read all the status information without scrolling across the display. The tape library needs either a bigger LED or smaller print.



Just Drop It in the Mail Slot

You don't have to open up the ADIC Scalar 458 2000XT and the Qualstar TLS-4220 to insert a tape; you just feed it into the face of one of these big tape libraries. You can put cartridges in any of the Scalar 458's 10 open slots below the front control panel and then program what internal slot they are to be sent to. The TLS-4220 has one available tape slot at the top of the unit.

Data Backup over the Phone

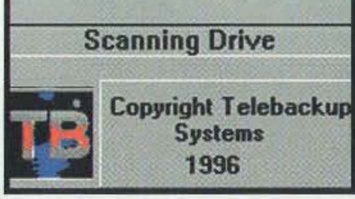
You've ordered Chinese takeout and pizza over the phone, so why not call to order data backup? This spring, Canadian-based Telebackup Systems, Inc., released a software package that backs up hard drives over standard telephone lines. TSI is currently licensing the technology to Internet service providers (ISPs) and telephone utilities, which will offer the backup service to any modem-attached user.

TSI's CEO Byron Osing says that value-added service providers will most likely charge a monthly fee of between $15 and $20 for daily backups of a PC. So far, TSI has reached an agreement with Toronto-based Hookup Communications, a large ISP, to utilize the technology. Osing says that many U.S. health-care providers have expressed interest in the off-site storage solution. Telebackup can perform daily backups on as many as 2500 standard PCs per day.

Of course, using a telephone line to make daily backups of a hard drive makes most people think twice. It can take up to 10 hours to initially back up a 1-GB hard drive over the telephone lines, but Osing says that Telebackup can detect the files used during the day and back them up in approximately 5 to 10 minutes. It does this using a cyclic redundancy check (CRC), which is a method for verifying data transmission by comparing numbers at the sending and receiving ends. You can restore single files from the off-site provider or get a complete off-site CD-ROM copy of your hard drive in case of hardware theft or a disk calamity.

The Telebackup service is limited to DOS and Windows 3.x, 95, and NT on the client side, but Osing says that the company will soon extend it to OS/2 and other platforms. Targeted at small businesses and home users, Telebackup poses no threat to on-line tape-library storage. TSI, however, plans to spin off a LAN-backup product later this year.

–John McDonough



Telebackup

Backup in Progress

Initializing Session

0%

Scanning Drive

Copyright Telebackup Systems 1996

Telebackup
About $15 to $20 per month

Telebackup Systems, Inc.
Calgary, Alberta, Canada

(403) 283-3995
http://www.telebackup.com

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At Home
The Internet contains many .ZIP files you can access through a World Wide Web browser. PKZIP also lets you archive files such as the digitized family photo album or annual budget in .ZIP files, saving you space on your hard drive.

On the Road
Use .ZIP files when sending email, storing presentations, or transferring files between your office PC and your laptop.

At the Office
Network and system administrators save space on their servers and reduce traffic over the intranet or corporate network using .ZIP files.

Data compression is as important now as it was when hard drives were small and modems were slow. New software applications and the files they create continue to grow in size. Intranet and Internet traffic are growing at a phenomenal rate. These growing trends make zipping and unzipping data files an important utility for everyone who uses a personal computer.

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The PKWARE Data Compression Library® products allow you to incorporate data compression technology into your software applications. The application program controls all the input and output of data, allowing data to be compressed to or extracted from any device or area of memory.

The all-purpose Data Compression Algorithm compresses ASCII or binary data quickly. The routines can be used with most compatible language compilers. Separate DOS, DOS32, Windows, OS/2, Win32 and UNIX versions are available! Call for pricing.

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1992 Première Computing Magazine Award
1992-1995 PC Computing World Class Award
1993 Shareware Industry Award

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Circle 188 on Inquiry Card

The makings of a great BLT.

High Speed
Takes just a few minutes to make and even less time to eat.

Huge Capacity
Load up with as much bacon, lettuce, tomato and mayo as you can handle.

Fast and Easy
Anyone can make one, no gourmet chef required.

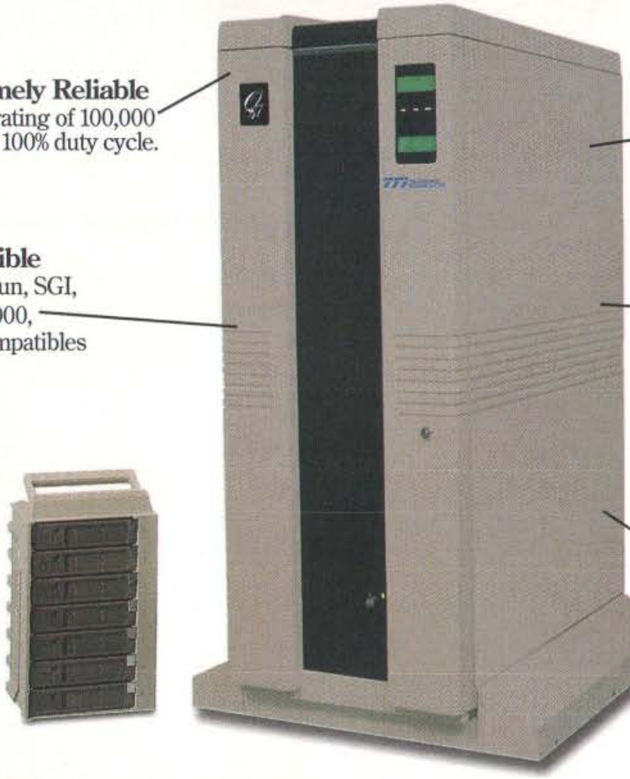
Extremely Reliable
Always tastes the same, no matter how many times you eat one.

Very Compatible
Goes great with cole slaw, potato chips, pretzels, soda, milk, orange juice, beer, etc.

The makings of a great DLT.

Extremely Reliable
MTBF rating of 100,000 hours at 100% duty cycle.

Very Compatible
Works with DEC, Sun, SGI, HP, IBM RS/6000, AS/400, PCs and compatibles and more.



Huge Capacity
Store up to 4.2 TB on 60 data cartridges.

Fast and Easy
Back up 1.1 TB unattended in less than 8 hours using library management software for UNIX, VMS, Novell and more.

High Speed
Back up over 20 MB per second.

Store up to 4.2 TB at over 20 MB per second.

Backup So Easy, You Can Do It With Your Eyes Closed.

Hungry for high performance tape backup? TTi's Q Series Digital Linear Tape (DLT) libraries are a very tasty solution. The Q Series comes packaged in two configurations, including 2 or 4 drives, providing random access of up to 60 data cartridges. That's a whopping 4.2 TB with data transfer speeds exceeding 20 MB per second! In addition, with the Q Series you can choose from 3 tape drive types: DLT 2000XT, DLT 4000 or DLT 7000.

The Q Series is compatible with a wide variety of library management software packages for UNIX, VMS, Novell and more. It's perfect for Hierarchical Storage Management (HSM) applications and standard network backup. And of course, the Q Series is backed by a full 2 year warranty.

The Q models come in desktop and desk-side versions, featuring an intelligent LCD operator panel which displays library activity and drive status. The Q Series is plug and play compatible with DEC, Sun, HP, SGI, IBM AS/400, IBM RS/6000, PCs and compatibles and more. Are you ready to get a taste of the fastest high-capacity backup solution? Call TTi today.

TTi TRANSITIONAL TECHNOLOGY, INC.

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FAX: (714) 693-0225
E-mail: info@ttech.com
http://www.ttech.com

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Circle 166 on Inquiry Card (RESELLERS: 167).

Test Specs

We evaluated the performance of these 12 tape libraries by timing their network backup and restore speeds. Our testers also examined the tape auto-loaders to see which ones were the easiest to set up and then picked the units' most important features. We tested and scored each element separately and computed an overall score in each media-technology area (i.e., DLT, 4 mm, and 8 mm) by assigning a weight to each element: technology (10 percent), implementation (40 percent, which is further divided into 45 percent for features, 45 percent for usability, and 10 percent for value), and performance (50 percent).

We ran our PC-based performance benchmarks on a 120-MHz Pentium system from S.A.G. Electronics running Windows NT. We created a directory tree with 920 MB of data on the computer's hard drive; the files in the directory tree varied in size and had different levels of compression. We tested the performance of the tape libraries by backing up and restoring the directory using Cheyenne Software's ARCserve 2.01 for Windows NT. We also ran another restore test by backing up a single 115-MB directory from within the tree.

Usability scores are based on such aspects as the clarity and organization of the user's manuals. Our testers check to see whether the documentation clearly defines status-indicator functions, and we also examine the illustrations to see if they are easy to understand. In addition, we make sure the LED indicators let you know if compression is on or if the tape is dirty. Our hands-on approach to testing includes evaluating how easy it is to install the tapes and the magazine clips and how accessible the jumper switches are to get to.

For features, we weight and score the important characteristics that we believe a tape library should have. As with most products that we test, the length and coverage of a warranty are always a primary concern. It's also important to pick a tape auto-loader that supports as many network OSes (NOSes) and third-party backup software applications as possible. Finally, we consider the cost and size of the units for the budget-minded and for those who are concerned with conserving office space.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of its monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

The World of Hierarchical Storage Management

Data that's archived to off-line storage devices may rarely be needed, but network administrators still must identify, move, and maintain it. To do this effectively, they need a special method for managing off-line storage.

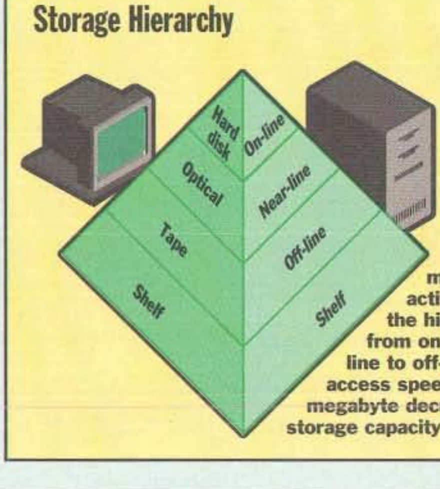
Hierarchical storage management (HSM) automatically and transparently migrates data from a file server's hard drive to less-expensive near-line or off-line storage (see the figure "Storage Hierarchy"). When files are migrated, stub files are left in primary storage as placeholders; thus, all files remain visible in the network file system, and you can still view and access them.

Five industry-accepted guidelines, or levels, help define HSM: automatic migration of files with transparent retrieval; real-time, dynamic load balancing of free disk space based on predefined thresholds; management of layers of storage hierarchy with dynamic balancing; migration of files based on data type through the use of policies; and object management support.

Several companies—including Cheyenne Software ((516) 465-4000), IBM ((800) 426-2255), Platinum Technology ((708) 620-5000), Seagate Software (formerly Arcada and Palindrome; (407) 333-7500), and Wang Software ((303) 444-4018)—support most, if not all five, levels. IBM's AdStar Distributed Storage Manager (ADSM) is one of the few storage solutions that supports a wide variety of platforms and all five HSM levels. Recently IBM announced support for Windows NT on the server side and an optional automated disaster-recovery plan. (For more on HSM-related software, see "Network Storage Economizers," March 1995 BYTE.)

With an HSM solution, you can potentially decrease physical storage expenses, reduce storage management costs, quicken data access, increase end-user productivity, optimize use of storage devices, and speed data backup. Installation and setup may be monumental, but the benefits make it well worth it. **–Susan Colwell**

Storage Hierarchy



As HSM products migrate less-active files down the hierarchy (i.e., from on-line to near-line to off-line), the access speed and cost per megabyte decrease and the storage capacity increases.

TAPE LIBRARIES FEATURES

VENDOR	**ADIC** **Scalar 458 2000XT**	**ADIC** **VLS (Virtual Library System) 4mm**	**Aiwa America, Inc.** **AL-D220 AutoLoader**	**Exabyte Corp.** BYTE BEST **210 8mm Tape Library**	**Exabyte Corp.** BYTE BEST **218 4mm Tape Library**
Base price (MSRP)	$39,995	$9295	$5995 (single-drive)	$6000	$5500
Price as tested	$50,995	$9295	$7995 (dual-drive)	$13,325	$11,500
Overall rating	★★★★	★★★★	★★★	★★★★	★★★★
PHYSICAL SPECIFICATIONS					
Drive manufacturer	Quantum	Hewlett-Packard, Sony, Seagate, Wang-DAT	Sony	Exabyte	Hewlett-Packard
Number of tape drives (std./max./as tested)	2/4/4	2/2/2	1/2/2	1/2/2	1/2/2
Number of tape banks (std./max./as tested)	48/58/48	15/15/15	17/17/17	1/1/1	1/1/1
Bar code scanner	Yes	N/A	N/A	Optional	Optional
Dimensions in inches (W × D × H)	19.5 × 23.5 × 40.3	17.4 × 16.25 × 8	8.125 × 12.25 × 16	9.5 × 21.4 × 22	9.5 × 21.4 × 22
Weight (lbs.)	171	32	26	78.5	78.5
PERFORMANCE					
Recording method	DLT	PRML	Helical-scan	Helical-scan	Helical-scan
Average access time (seconds)	60	<40 sec. for 120-inch tape	35 sec. for 120-mm tape	90	40
Sustained compressed transfer rate (KBps)	2500	732	1024	1000	2048
Tape length (meters)	1800	60, 90, 120	60, 90, 120	160	120
Buffer size (MB)	2	1	1	1	1
Drum-rotation speed (rpm)	N/A	2000 to 5000	4000	1831	2000
RELIABILITY					
MEBF (exchanges)/duty cycle (percent)	100,000/100	80,000/20	160,000/10	160,000/10	200,000/10
Nonrecoverable read-error rate	1×10^{17}	1×10^{15}	$<1 \times 10^{15}$	$<1 \times 10^{17}$	$<1 \times 10^{15}$
DATA RECORDING					
Maximum number of cartridges	58	15	17	11	19
Max. cartridge capacity/overall capacity with compression (GB)	70/3.96 TB	8/120	8/136	14/154	8/152
Max. cartridge capacity/overall capacity without compression (GB)	35/1.98 TB	4/60	4/68	7/77	4/76
Cost per GB	$30.35	$154.92	$117.57	$173.05	$151.32
Number of read/write heads	1	2	4	4	4
Tracks per inch	256 per half-inch tape	2790 per 4-mm tape	2791 per 4-mm tape	1638 per 8-mm tape	N/A
ADDITIONAL CHARACTERISTICS					
SCSI adapter included	✓		✓	✓	✓
Number of SCSI ports	1	1	2	1	1
Serial interface	✓				
Number of SCSI addresses necessary to use unit	5	2 for 1 drive/ 3 for 2 drives	3	Up to 2	Up to 2
Password-protected	Mailbox only	Software-dependent		✓	✓
OSES SUPPORTED					
Windows/DOS	✓	✓	✓	✓	✓
OS/2-Warp	✓	Certification in progress	✓	✓	✓
Windows NT	✓	✓	✓	✓	✓
Windows 95	✓	✓	✓	✓	✓
SCO Unix/SCO Xenix	✓	✓	✓	✓	✓
Apple A/UX		Certification in progress	✓	✓	
Other	System 7, 411 Unix Platform 1, AS-400	N/A	N/A	N/A	N/A
SOFTWARE SUPPORTED					
Cheyenne ARCServe	✓	✓	✓	✓	✓
Palindrome Network Archivist	✓		✓	✓	✓
Arcada Software Backup Exec	✓	✓	✓	✓	✓
Rexon ProServe CX/Sytos Plus					
System Independent Data Format (SIDF)			✓	✓	✓
Novell Storage Management Services (SMS)	✓		✓	✓	✓
NETWORK SUPPORT, SERVER ATTACHED[1]					
Novell NetWare 4.x	✓	✓		✓	✓
Novell NetWare 3.x	✓	✓		✓	✓
Microsoft Windows NT Server	✓	✓		✓	✓
Banyan Vines	✓	✓		✓	✓
IBM LAN Server	✓	✓		✓	✓
WARRANTY					
Warranty length (years)/coverage	2/P, L, R	2/P, L, R	2/P, L, R	2/P, L, R	2/P, L, R
FCC classification	B	B	A	B	A
Phone	(206) 881-8004	(206) 881-8004	(201) 512-3606	(303) 442-4333	(303) 442-4333
Toll-free phone	(800) 336-1233	(800) 336-1233	(800) 321-2492	(800) 392-2983	(800) 392-2983
On-line address	http://www.adic.com	http://www.adic.com	N/A	http://www.exabyte.com	http://www.exabyte.com
Inquiry number	**1063**	**1064**	**1065**	**1066**	**1067**

BYTE BEST = BYTE Best

✓ = yes;
N/A = not applicable.

Warranty: P = parts; L = labor;
F = freight to repair center; R = return to customer.

★★★★★ Outstanding
★★★★ Very Good
★★★ Good
★★ Fair
★ Poor

Hewlett-Packard Co. **SureStore 12000e**	**Micro Design International** **SCSI Express 2000DC**	**Overland Data, Inc.** **DLT Library Xpress/ LXB 2210 Base Module**	**Qualstar Corp.** **TLS-4220**	**Quantum Corp.** **DLT 2500XT**	**Seagate Technology** **4586 NP**	**Storage Solutions, Inc.** **DATa-ray 32**
$3510	$3595	$10,995	N/A	$4995	$2471	$6995
$3510	$3595	$15,495	$12,500	$4995	$2471	$9995
★★★★	★★★★	★★★★★	★★★★	★★★★	★★★	★★★
Hewlett-Packard	Hewlett-Packard	Quantum	Exabyte	Quantum	Seagate/MKE	Hewlett-Packard, Wang-DAT
1/1/1	1/1/1	2/16/2	2/2/2	1/1/1	1/1/1	3/5/5
6/6/6	1/1/1	1/8/1	2/2/2	5/5/5	1/1/1	1/1/1
N/A	N/A	Optional	Optional	N/A	N/A	N/A
6.5 × 10.63 × 5.28	198 × 356 × 139 mm	19 × 23 × 8	13 × 21.3 × 31.8	16.3 × 10.5 × 11.8	5.7 × 8 × 3.2	6.625 × 10⅜ × 17
11	13	70	70	35	9	20
DDS-1 & DDS-2 (tape-dependent)	DDS-DC and DCLZ	DLT	Helical scan	Serial serpentine	Helical scan	Helical scan
30/90-meter; 40/120-meter	30 to 40	45	90	68	30 to 40 (90- to 120-meter tape)	45
1020	1536	2500 to 3000	1000	2500	800	17,408
60, 90, 120	60, 90,120	540	160	1828	90,120	90,120
1	1	2	1	2	1	1
5737	5737	N/A	1831	N/A	4000	5737
35,000/30	40,000/30	280,000/100	500,000/100	500,000/100	100,000/20	200,000/12
$<1 \times 10^{15}$	$<1 \times 10^{15}$	$<1 \times 10^{17}$	$<1 \times 10^{17}$	1×10^{17}	$<1 \times 10^{15}$	$<1 \times 10^{15}$
6	6	10	20[2]	5	12	5
8/48	8/48	30/300	14/280	30/150	32/384	8/40
4/24	2.6/16	15/150	7/154	15/75	16/192	4/20
$146.25	$224.69	$103.30	$81.17	$66.60	$12.87	$499.75
2	1	2	4	12	4	20
2800 per 4-mm tape	2790 per 4-mm tape	128 tracks per half-inch tape	1638 per 8-mm tape	256 per half-inch tape	2804 per 4-mm tape	N/A
	Optional	✓		✓	Optional	
1	2	2	3	✓	2	2
		✓		✓		
1	1	2 to 3 per base module	Number of drives installed plus 1	1	2	3 to 5
✓	✓	✓	✓			Software-dependent
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓		✓
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓		✓
✓		✓	✓	✓	✓	✓
✓		✓	✓	✓	✓	
N/A	N/A	Sun Solaris, HP-UX, AIX, IRIX	All Unix, VMS	N/A	N/A	N/A
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓		✓	✓
✓	✓	✓	N/A		✓	✓
✓	✓	✓	N/A		✓	✓
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	
✓	✓	✓	✓		✓	
✓	✓	✓	✓	IBM ADSM	✓	
1/P, L, F, R	1/P, L, R	2 (on-site)/P, L, F, R	2/P, L, R	2/P, L, R	2/P, L, R	3/P, L, R
B	B	A	A	B	B	B
Contact local HP dealer	(407) 677-8333	(619) 571-5555	(818) 592-0061	N/A	(714) 641-1230	(203) 325-0035
(800) 843-4772	(800) 228-0891	(800) 729-8725	(800) 468-0680	(800) 624-5545	(800) 626-6637	(800) 745-5508
http://www.hp.com	http://www.microdes.com	http://www.ovrland.com	http://www.qualstar.com	http://www.qntm.com	http://www.seagate.com	http://www.ssi-usa.com
1068	**1069**	**1070**	**1071**	**1072**	**1073**	**1074**

[1] Subsystem can directly attach to network server by using NLM, VAP, or server process, with driver software running under server OS and disk physically connected to server.

[2] Plus two fixed cartridge locations.

Microsoft's Suite Victory

Office 95 loses some battles but wins the war against Corel WordPerfect Suite and Lotus SmartSuite 96.

By David Seachrist and Russell Kay

There's no question who sells the most office applications and suites. Microsoft's Office 95/Office Professional won that contest long ago, leaving Lotus's SmartSuite 96 and Corel's new WordPerfect Suite/Office Professional to fight for a distant second place. However, is Office 95 your best choice? Virtually every new Windows computer today comes with one of these three suites installed, so for most people, the choice is automatic—they use what they have. But inexpensive upgrade pricing makes each package affordable to virtually every business user.

To help sort out the contenders, NSTL and BYTE examined the latest versions of all three suites. NSTL tested the Microsoft and Lotus suites, and BYTE put the Corel suite through its paces.

We are deliberately ignoring entry-level suites, such as ClarisWorks, which are aimed primarily at home and first-time users. Also, we don't cover every application in the three suites, concentrating on word processors, spreadsheets, and, to a lesser extent, personal information managers (PIMs).

Corel's New Contender

As the newest 32-bit kid on the block, the Corel WordPerfect Suite has been the object of considerable curiosity. The applications are very good, integration is reasonably good, and users will applaud new owner Corel's decision to reinstate free telephone support. (Well, the phone call to Utah isn't free anymore, but the capable help is.) This may not be the best suite, but it's technically interesting. It also offers the greatest variety of applications and extras.

In our tests, it became apparent that Corel uses more shared code, more consistently, than either Office or SmartSuite. Shared spelling checkers are commonplace; shared thesauri are much less so.

BYTE BEST

OFFICE SUITES

Microsoft Office Professional offers a world-class set of productivity applications, nosing out its two competitors. Its cross-application functions are excellent.

We tested the basic suite, which has no database product in it. The upgraded version, Corel Office Professional, includes Borland's Paradox DBMS. It should be available by the time you read this article.

The latest WordPerfect is as good as a word processor gets. It will do virtually everything the other two can and some things they cannot. For example, when your mouse cursor is on a paragraph or a table cell, a little box icon (called a HotSpot) appears on the edge of the area. Clicking on it selects that object and brings up a menu of possible actions. This proves considerably faster and less distracting than going to the menu or toolbar. Also, WordPerfect's Reveal Codes mode has no peer for sorting out formatting problems.

WordPerfect Suite is a highly Internet/intranet-aware package. It can publish directly to Hypertext Markup Language (HTML) and Standard Generalized Markup Language (SGML), and it can read and view those formats directly. It comes with Netscape 2.01 and AT&T's WorldNet service. While they install separately, they are immediately accessible from within WordPerfect, Quattro Pro, and Presentations.

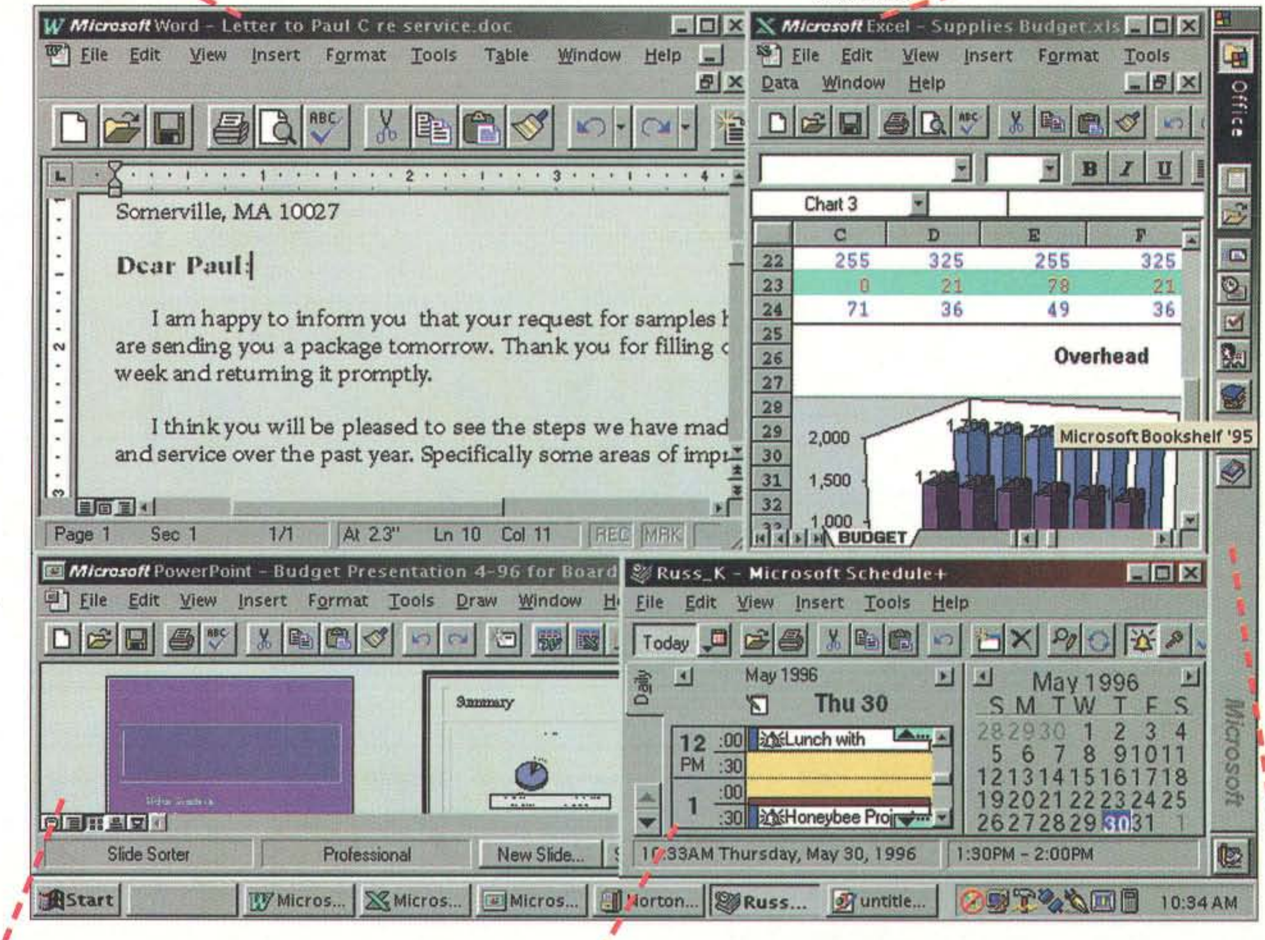
Instead of a separate toolbar, the application manager integrates into the Windows 95 taskbar. Overall, we found the suite consistent and easy to use, but it's evident that the major applications all originated as separate products. Unlike Microsoft's suite, where Word and Excel are comparable in terms of development, WordPerfect is clearly more mature and polished than the other components in its suite. For example, with WordPerfect, it's possible to rotate text inside a box, something you can't do in Word. However, Quattro Pro can't rotate a column header within a cell, while Excel can. While Quattro Pro has been enhanced, it's not quite up to its competitors.

File management is consistent from application to application, but it's less convenient than in PerfectOffice 6.1. It requires considerably more mouse action than we prefer. WordPerfect now supports e-mail routing and revision options suitable for group projects. It works well enough, but Word and WordPro are better.

WordPerfect Suite's schizophrenia about PIMs isn't so sweet, however. Starfish Software's handy Sidekick 95 is the

Word has been a leader in WYSIWYG displays.

Excel continues to set the standard against which all other spreadsheets are compared for features, functionality, and ease of use.


Microsoft Word - Letter to Paul C re service.doc
File Edit View Insert Format Tools Table Window Help
Page 1 Sec 1 1/1 At 2.3" Ln 10 Col 11 REC MRK
Microsoft Excel - Supplies Budget.xls
File Edit View Insert Format Tools Data Window Help
Chart 3
Overhead
2,000
1,500
1,000
BUDGET
Microsoft Bookshelf '95
Office
Microsoft PowerPoint - Budget Presentation 4-96 for Board
File Edit View Insert Format Tools Draw Window H
Summary
Slide Sorter
Professional
New Slide...
Russ_K - Microsoft Schedule+
File Edit View Insert Tools Help
Today
Daily
May 1996
Thu 30
12 PM :00 :30
1 :00 :30
Lunch with
Honeybee Proj
May 1996
S M T W T F S
28 29 30 1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31 1
10:33AM Thursday, May 30, 1996
1:30PM - 2:00PM
Microsoft
Start
Micros...
Micros...
Micros...
Norton...
Russ...
untitle...
10:34 AM

Somerville, MA 10027

Dear Paul:

I am happy to inform you that your request for samples h are sending you a package tomorrow. Thank you for filling c week and returning it promptly.

I think you will be pleased to see the steps we have mad and service over the past year. Specifically some areas of impr

	C	D	E	F
22	255	325	255	325
23	0	21	78	21
24	71	36	49	36

PowerPoint, the basis for many on-screen slide presentations, has a slide-sorter mode that shows multiple pages in the same window.

Schedule+ handles personal calendars and group scheduling.

The **Office Shortcut Bar** is highly configurable on any edge of the screen or as a floating palette. You can switch between several toolbars, customize any of them, and set the Shortcut Bar to auto-hide, which is useful for smaller screens.

A strong set of applications helps Office continue to dominate its category.

basic stand-alone PIM. Unfortunately, Corel made no attempt to tie it into the suite, which has its own address-book module. To complicate things further, Corel Office Professional will include yet another PIM, Novell's InfoCentral, for a total of three.

Of course, not everything was "perfect." When we repeated setup to install an application that was omitted the first time, the setup program didn't remember which components and options we had selected previously. Thus, we had to think our way carefully through the entire process to avoid uninstalling something we wanted to keep. When we reran setup another time to check disk-space requirements, the program kept telling us to close down a running application—an unnamed PerfectScript macro. However, every time we closed it down, the setup program started it up again and then complained. Finally, while writing this review with WordPerfect, we created a table of features and went to save it as a Quattro Pro spreadsheet. Guess what: Our only options were *previous* versions of Quattro.

Corel's suite includes some useful extras. It comes with Starfish's Dashboard 3.0 and Novell's Envoy electronic-document system. The QuickTasks icon brings up an organized list (which you can modify and add to) of common tasks, such as writing a letter, calculating a loan amortization, or creating a numbered list. QuickView Plus from Inso integrates nicely with Norton Navigator and Windows 95 Explorer as well as WordPerfect Suite, considerably expanding the number of file types you can view with a mouse-click.

CorelFlow, a full-featured charting program, is included on the CD, though its installation requires another step. Finally, as we've come to expect in any Corel package, there are loads of art clips and 150 TrueType fonts. (See the features table on page 115 for a more detailed list of components.)

Lotus's SmartSuite 96

From a company that's staked its future on a groupware product, Notes, you'd expect a desktop application suite that encourages collaboration, and Lotus's suite does deliver exceptional team functionality. Although the product's name is SmartSuite 96, the version we tested lacks a 32-bit spreadsheet and PIM/group scheduler applications. Long-overdue replacements for Lotus Organizer and Lotus 1-2-3 are due this summer.

The coexisting old/new applications in SmartSuite 96 illustrate Lotus's progress in revamping the user interface. In its 32-bit applications, you can select formatting options for data, text, and graphical objects via a floating property dialog box, the InfoBox. NSTL usability testers liked the InfoBox because it lets you preview property changes on-screen. Also, NSTL found that SmartCenter's simple and intuitive file-cabinet metaphor made it easy to learn file management tasks.

However, the real benefits of the newer Lotus applications, which are sorely missed in the older ones, are the new productivity tools: a common menu structure, a natural-language-based help system, Internet features, and collaborative-computing enhancements.

TeamMail is SmartSuite's tie-in to e-mail systems. It allows sending files or portions of files from within WordPro, Freelance Graphics, and Approach. The ease of use varies by task.

Testers found that the TeamReview features in WordPro made it easier to use than Word for electronic-document routing. WordPro's versioning feature, which allows you to maintain successive versions of a document within a single file, makes this perhaps the best choice if you need audit trails.

WordPro and Freelance Graphics allow opening and saving HTML files on a Web server out of the box. In addition, WordPro can open and save document files to an FTP server. SmartSuite 96 comes with ScreenCam, which allows you to record screen shows of computer operations. This is a great tool for support personnel to teach users how to perform software tasks by example.

Microsoft Office Professional

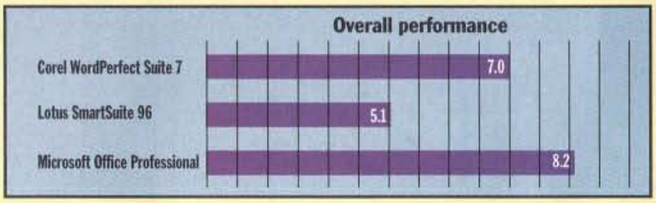
The maturity shows in this impressive set of applications. Office is now in its fourth generation (it started with version 3.0), and

OFFICE PRODUCTIVITY SUITES

BEST OVERALL

Microsoft Office Professional

This package does just about everything well. It's fast, and its powerful component applications are well integrated in a way that's transparent to users.

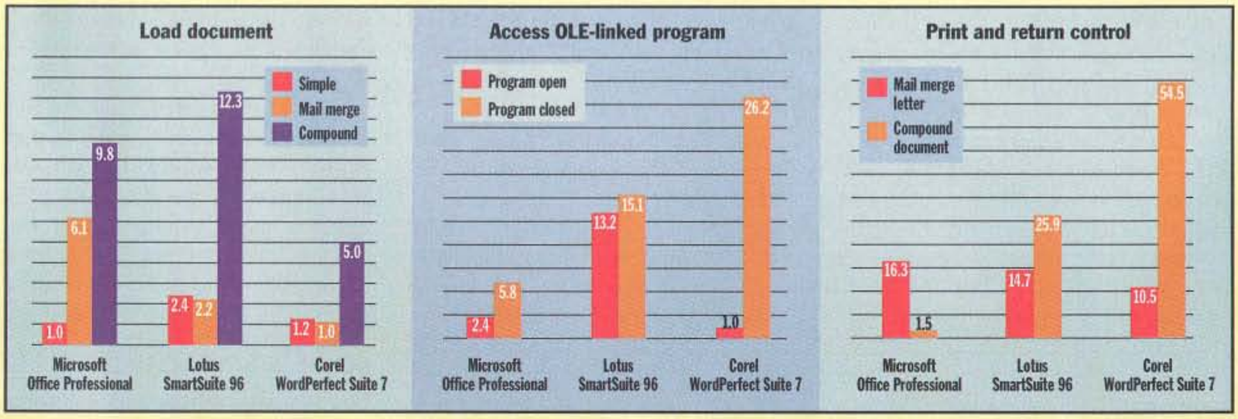

Overall performance

	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	OVERALL VALUE
Microsoft Office Professional and Bookshelf	**$599**	★★★★	★★★★	★★★★	★★★★	★★★★★
Lotus SmartSuite 96 Edition	$399	★★★	★★★	★★	★★★★	★★★
Corel WordPerfect Suite 7 for Windows 95	$395/ $595	★★★★	★★★★	★★★	★★★★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

PERFORMANCE

All tests were conducted on a Dell Dimension XPS P133c with 16 MB of RAM. The compound document contained tables and charts linked to a spreadsheet. The Corel suite took considerably longer to update links or access the linked program when it wasn't already loaded. The Lotus applications took longer to load documents of all types and to access links, at least in part because of the 16-bit components. Additional tests indicated that extra RAM sped up many of these operations. We expect that Corel can and will do more performance tuning that will significantly improve WordPerfect Suite's performance.


Load document

Access OLE-linked program

Print and return control

Microsoft has been diligent about refining it and adding impressive functions. The individual applications are first-rate and well integrated with common dialog boxes, menus, icons, and toolbars. Perhaps nothing better exemplifies Office's suiteness than the Binder.

Although this is perhaps the least-known feature of Office, it's one of the most productivity-oriented, because it lets you combine parts of documents from a variety of sources and applications into a single object, a new data type. OLE 2.0 automation in all three suites lets you incorporate into a single document objects that are created with different applications and maintain these as live links that reflect any updating from one application to another. The Binder may be Office's best-kept secret.

Office is a terrific tool for handling compound documents (see the Tech Focus on page 116 for more details). Our testers appreciated Office's flexibility in managing and accessing documents once they learned how to use the Shortcut Bar to create new documents by category and the File Binder to electronically paper-clip together related pages from different files created by different applications. Testers noted that with the start-a-new-document button, you don't need to know which application you need, only the type of document.

All the Office components are 32-bit applications, primarily ports of the last 16-bit versions for Windows 3.1, but with subtle enhancements. For example, as with the other suites, checking spelling need no longer be a separate editing process. In real time as you type, Word places wavy red lines under words that aren't in its shared spelling dictionary. A right mouse-click on a marked word provides a list of suggested alternates.

Microsoft keeps fine-tuning little things. If you type a numeral and a period at the beginning of a paragraph, Word's AutoFormat guesses that you're creating a numbered list and automatically inserts the next number in the sequence when you start the next paragraph.

When you're entering a column of value labels in a spreadsheet, Excel suggests new entries based on previous values in the column. Type *Northern division* in a column, and the next time you type *n* in that column, Excel automatically suggests *Northern division* to complete that cell. If you don't want to take that suggestion, it

FEATURES

	LOTUS SMARTSUITE 96	MICROSOFT OFFICE PROFESSIONAL	COREL WORDPERFECT SUITE
Version	None listed	95.b	7.0.0
Word processor	WordPro 96	Word 7.0	WordPerfect 7
Spreadsheet	1-2-3 release 5 (16-bit)	Excel 7.0	Quattro Pro 7
Graphics	FreeLance 96	PowerPoint 7.0	Presentations 7, CorelFlow 3
Database	Approach 96	Access 7.0	Paradox 7 (COP)
PIM	Organizer 2.1 (16-bit)	Schedule+	Sidekick 95, InfoCentral 7 (COP)
Application manager	SmartCenter	Office Shortcut Bar	Desktop Application Director, Dashboard 3.0
Shortcuts, cross-application integrators	SmartMasters	Binder	QuickTasks, QuickConnect
On-line service, Web browser	Global Network Navigator	MSN, Internet Explorer 2.0	AT&T WorldNet, Netscape Navigator 2.01
Workgroup features	TeamReview, TeamConsolidate, TeamSecurity	Routing, Word, and Excel revisions	WP revisions
Group scheduling	Optional add-in	Schedule+	GroupWise client (COP)
Macro language	LotusScript	Visual Basic for Applications, WordBasic	PerfectScript
Electronic publishing	Acrobat reader, HTML	HTML	Envoy 7, HTML
SDK included?			COP
Current version for which OS platforms (compatible version)	Win 95, Win 3.1, OS/2	Win 95, Win NT 3.51, (Mac–NoDB)	Win 95, (Win 3.1–V6)
Hard disk space (minimum/maximum installation)	74/150 MB	40/126 MB	89/360+ MB
RAM (minimum/recommended)	8/12 MB	8 (12 for Access)/16 MB	8/16 MB
APPLICATION MANAGER ENHANCEMENTS			
Add programs, folders, and documents to application manager	✓	✓	✓
Access Web URL from application manager	✓		✓
Fix application manager to top, bottom, or sides of screen	T,B	✓	B
Hide toolbar when not in use	✓	✓	✓
WORD PROCESSOR ENHANCEMENTS			
Formats as you type	FC	✓	✓
Find and replace with proper verb form		✓	✓
Edit and check spelling simultaneously	✓	✓	✓
Document section tab dividers	✓		
SPREADSHEET ENHANCEMENTS			
Graph by map	✓	✓	✓
Point-and-click temporary calculations		✓	
Automatic cell completion based on previous column values		✓	
Multiple page display in print preview	✓		
Automatic list filtering		✓	
Access database forms and reports	✓	✓	N/A
DATABASE ENHANCEMENTS			
Database design assistant	✓	✓	N/A
Query assistant	✓	✓	N/A
Report assistant	✓	✓	N/A
Data normalizing assistant		✓	N/A
Performance analysis assistant	SI	✓	N/A
Point-and-click break out of summary data into detail	✓		N/A

N/A=Not included in package tested; SI=Smart-indexing technology; V6=Version 6.1; COP=in Corel Office Professional; NoDB=No database module; FC=Format Check looks for some formatting errors; ✓=yes vanishes when you type the next letter.

As a tool for collaborative projects, Office is useful, though not up to the Lotus standard. Specifically, Word's options for routing a document for review aren't as complete or centralized as WordPro's.

Office Professional comes with Microsoft Bookshelf on a second CD-ROM. Bookshelf contains a full dictionary and other reference works. The dictionary is integrated into Word, so you can look up definitions of words by right-mouse-clicking on them in Word and choosing the Define option. The package also has an image-manipulation program that supports TWAIN-compatible scanners.

Decisions, Decisions

If we were creating an ideal suite, with the ability to choose any components, it might look like this: WordPerfect, QuickTasks, and Sidekick from Corel; Excel, PowerPoint, Access, WordBasic, and the Office Toolbar from Microsoft; the Team features from Lotus; Adobe's Acrobat; Norton Navigator's File Manager; and Netscape Navigator 2.x. However, that's not an option in the real world—not yet, anyway.

So if we have to choose one suite, which will it be? Right now, for wide adoption, we'd settle on Microsoft's Office Professional, or Office 95 for users who don't need Access.

SmartSuite 96's current 16-bit applications downgrade its usability, performance, and versatility slightly. When the next release of SmartSuite appears, its 32-bit applications, multiplatform and workgroup capabilities, and tighter integration with Notes will make it a front-runner for many organizations.

WordPerfect Suite was very close to the others, but its spreadsheet didn't match Excel's abilities, and we don't yet know how well Corel will integrate Paradox, which is still a third-party product. Nonetheless, one of us still prefers WordPerfect over Word and for personal use opts for the Corel suite.

The bottom line: You can't go too far wrong with any of these office suites. They're all excellent products, and they keep getting better (if bigger) with each release. B

David Seachrist has tested business software for NSTL for nearly a decade, primarily in the areas of desktop publishing and graphics. You can reach him on the Internet at **dseachrist@prodigy.com** *or on BIX at* **editors@bix.com.** *Russell Kay is a technical editor on BYTE's review staff. You can reach him at* **russellk@bix.com.**

Evaluations in this report represent the judgment of BYTE editors, based in part on extensive tests conducted by NSTL, Inc., as documented in a recent issue of its monthly Software Digest *covering the Microsoft and Lotus suites. To buy a copy of that report, with its own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE Magazine and NSTL are both operating units of The McGraw-Hill Companies.*

PRODUCT INFORMATION

Corel WordPerfect Suite 7
$395/$449 (CD/CD plus disk);
upgrade, $129/$179
Corel Office Professional 7
CD only, $695; upgrade, $249
Corel Corp.
Orem, UT
(801) 765-4010
fax: (801) 222-4379
http://www.corel.com
Circle 1077 on Inquiry Card.

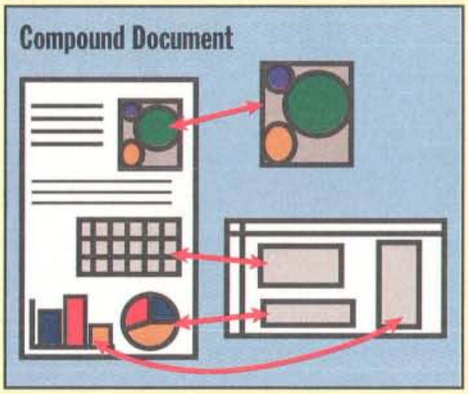
Office Professional
$599; competitive upgrade, $349;
version upgrade, $309
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 1078 on Inquiry Card.

SmartSuite 96
$199; upgrade, $149
Lotus Development Corp.
Cambridge, MA
(800) 343-5414
(617) 693-0253
fax: (617) 693-0968
http://www.lotus.com
Circle 1079 on Inquiry Card.

TECH FOCUS | OLE 2.0

Containing the Compound Document

In a sense, computer users have always had compound documents incorporating text, graphics, tables, and spreadsheet data. However, we assembled the elements manually, and often, for convenience, grouped similar data pages or graphics instead of putting them where they logically belonged on the page. Today's powerful integrated suites use OLE 2.0 to allow this more appropriate mixing of elements that you can print in place on color laser printers or publish to Web pages or CD-ROMs.



A document can contain text, links to graphics, spreadsheets, and other objects.

In Microsoft Office Professional, a new OLE extension called the Document Objects interface (DocObjects) allows two applications to be completely active at the same time. In previous versions of the product, when you used OLE to do an edit in place—an Excel spreadsheet that's embedded in a Word document, for example—the active object was in complete control; when you switched applications, the menu bar changed. However, with DocObjects, the two applications share the same menu bar.

DocObjects is based on a model in which an intelligent "frame" serves as a container for one or more documents. WordMail is an example of DocObjects in action. When you create a WordMail message, the header "belongs" to Mail while Word handles the text entry and editing. Pick the Edit, View, or Format menus, and you're issuing commands to Word. Pick File or Compose, and you're instructing Mail. The entire process is seamless to the user.

Another example is Microsoft Office's Binder, which is essentially a new file type: a container application, or frame, for a compound document. One of the simple but elegant options it allows is the ability to print a compound document, numbered sequentially across all pages, regardless of whether Excel, PowerPoint, or Word created any given page.

Over time, new container-type applications will appear. Indeed, today's typical Web browser is close to being a container application, with graphics, frames, tables, text, and even sound and video all working together.

Web Project

JavaScript Adventures

Netscape's interpreted scripting language remains a frustrating work in progress.

By Rex Baldazo

Editor's note: Jon Udell is working on a special assignment this month (see "Your Business Needs the Web" on page 68). He will resume writing this column next month.

At the BYTE Site, navigation is always on our minds. As our article archive gets larger, being able to help people browse or do research becomes more important. On the other hand, we have to make sure that any navigation tools we add won't undo the entire site.

I was thinking about these issues recently, and an epiphany hit: Why not build a small navigation window using Netscape's JavaScript?

The reasons to explore JavaScript were obvious. Besides the potential of producing a navigation tool, I might uncover traps and pitfalls that I could apply to other JavaScript development projects. But I found no shortage of pitfalls: As I learned how to program in JavaScript, I also discovered its limitations and the disappointing state of Netscape's documentation for the language.

Not Another Java

While Java and JavaScript are related, it's a distant relationship. Java is a compiled and strongly typed general-purpose language, while JavaScript is an interpreted and specific-purpose scripting language. JavaScript's designers aimed its features directly at manipulating Web pages and at interacting with the user.

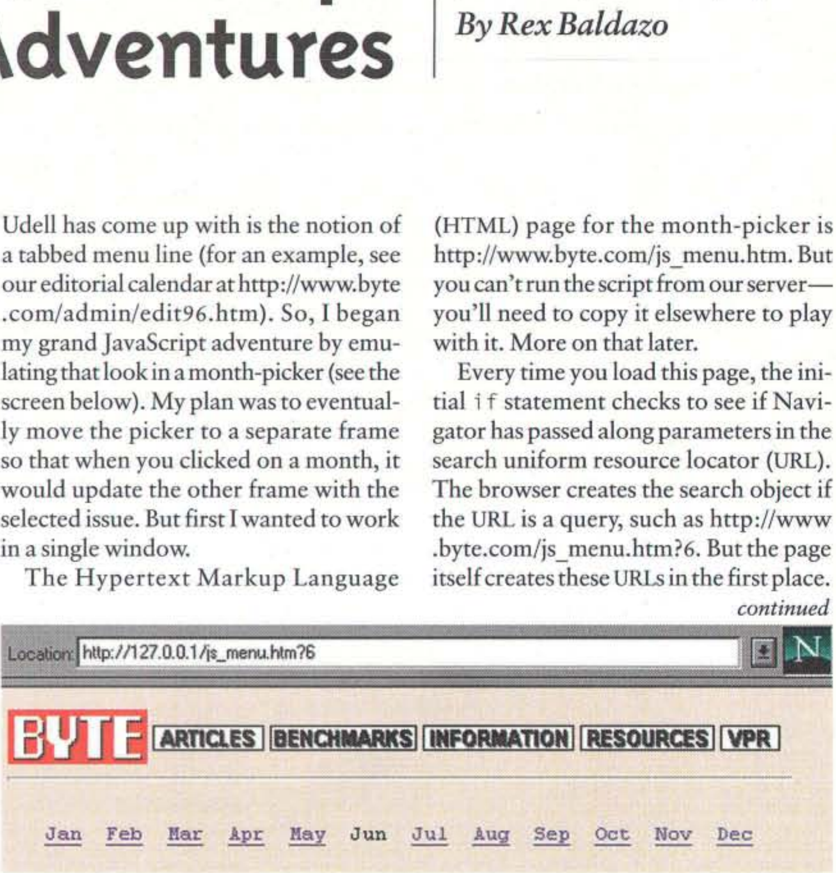
By the time you read this, Netscape Navigator 3.0 will be available. But I'm experimenting in 2.0, and, for the most part, these scripts should work in 3.0.

One of the nicer navigating ideas Jon Udell has come up with is the notion of a tabbed menu line (for an example, see our editorial calendar at http://www.byte.com/admin/edit96.htm). So, I began my grand JavaScript adventure by emulating that look in a month-picker (see the screen below). My plan was to eventually move the picker to a separate frame so that when you clicked on a month, it would update the other frame with the selected issue. But first I wanted to work in a single window.

The Hypertext Markup Language (HTML) page for the month-picker is http://www.byte.com/js_menu.htm. But you can't run the script from our server—you'll need to copy it elsewhere to play with it. More on that later.

Every time you load this page, the initial `if` statement checks to see if Navigator has passed along parameters in the search uniform resource locator (URL). The browser creates the search object if the URL is a query, such as http://www.byte.com/js_menu.htm?6. But the page itself creates these URLs in the first place.

continued



Location: http://127.0.0.1/js_menu.htm?6

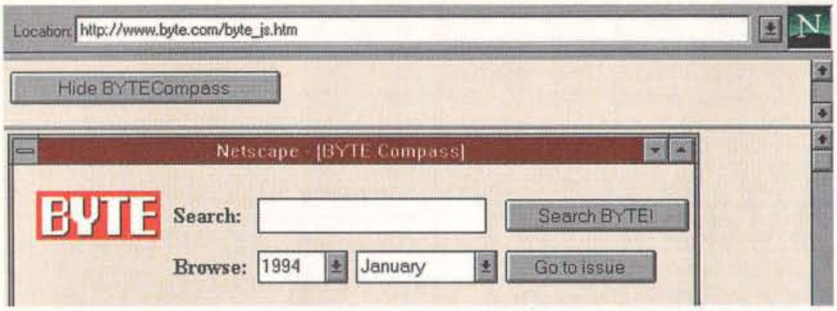
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Emulate the tabbed menu line (above) in JavaScript (below), and you'll uncover technical flaws.

The PrintMonthArray Function

```
function PrintMonthArray() {
 doc = self.document;
 doc.write("<PRE>  ");
 var path = location.pathname.substring
   (1,location.pathname.length);
 for(var i=1; i<=12; i++) {
  if (CurrentMonth == i) {
   doc.write(MonthArray[i].text + "  ");}
  else {
   doc.write("<a href=\"" + path + "?" + i + "\")>" +
        MonthArray[i].text + "</a>" + "  ");}
  }
 doc.writeln("</PRE>");
}
```

PHOTOGRAPH: KELLIE WALSH © 1996



Location: http://www.byte.com/byte_js.htm

Browse: 1994 January

The BYTECompass offers two frames: The single button opens and closes the window; the larger frame points to search results.

The `PrintMonthArray` function (see the listing on page117) makes an `<href>` tag for each month except the one that's currently selected. The `<href>`s are circular references back to the js_menu.htm page. The search object passes a number identifying which month you clicked. The browser redraws and reinterprets the page when you click on a month, and thus updates the currently selected month.

This discussion has probably raised two questions in your mind. First, why all this coding gymnastics to do what seems to be a simple window-redraw procedure? Second, why won't this action work from The BYTE Site? The answers to both questions rest squarely on the shoulders of Microsoft and Netscape.

JavaScript's documentation describes a `document.clear()` method that I should have been able to use to clear a document. Then I would have used two other built-in methods, `document.write()` and `document.writeln()`, to redraw the document. That would have been easier, and more direct, than using the search-object contortion.

Unfortunately, I haven't been able to get `document.clear()` to work as advertised on Navigator 2.0, 2.01, or 2.02 on either Windows NT or the Mac OS. I've also tried with the Atlas preview on NT. I haven't had a chance to experiment with JavaScript on Microsoft Internet Explorer 3.0, but it will be interesting to see if Microsoft can get it to work right.

This page doesn't work on The BYTE Site, but it works just fine on most of the servers that I've tried—WebStar (both the Macintosh and the Windows 95/NT versions), Netscape's FastTrack server, and even the little Web server that comes with Microsoft FrontPage. However, when I moved it over to The BYTE Site, which is powered by Microsoft's Internet Information Server, I kept getting errors. Depending on the security configuration of IIS, I got either a 403 (execute permission denied) or a 404 (not found) error. It's clear that IIS is trying to actually execute the HTML page.

According to Microsoft, the Internet specification on how to deal with queries is open to interpretation. Most vendors have settled on a common practice, while Microsoft took its own approach. That's why my script worked on most other servers but failed on Microsoft IIS. But bowing to the pressures of the market, version 2.0 of IIS will adhere to industry practice. The next version of IIS will ship with NT 4.0, so it may not be available when this article sees print, although you may be able to download a beta version from Microsoft's Web site.

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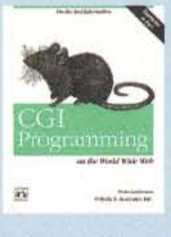

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One last point before we leave this script. You will notice that I use a little `MakeArray` function to create an array of objects. Navigator 3.0 provides a true array object, but for backward compatibility I'm using the older method.

Building a Compass

Having my client-side script fail to execute on the Microsoft IIS server unnerved me. But I had gained enough confidence in JavaScript to create the BYTECompass.

For this project, I decided I'd go whole hog, complete with frames and floating windows. The BYTECompass itself is a floating window that allows you to either browse articles by issue or run a search of BYTE's article archive. You can try out the BYTECompass by visiting http://www.byte.com/byte_js.htm.

When you point your browser at this file, the main window of your browser divides into two frames (see the screen above). The upper frame, which I call the *menu frame*, has a single button that you use to open or close the BYTECompass window. The lower frame points initially at the normal BYTE Site home page. As you select items in the BYTECompass, this lower frame points to the selected issue or search result. Thus, I call it the *art frame*, short for article frame.

This little navigation aid fulfills my main goal because it doesn't require any reworking of the existing BYTE Site. It's a totally transparent add-on for those who have a JavaScript-capable browser.

The byte_js.htm page has the functions to open and close the BYTECompass window. This page also has the code that draws the button in the menu frame. The frameset in byte_js.htm (see the listing "Main Frameset" on page 120) points the menu frame to a document called blank.htm. That page is essentially an empty HTML page, except for a single JavaScript statement invoking the `CallBack` function in the parent document.

The `CallBack` function could actually reside in the blank.htm document, but it's in the byte_js.htm document for historical reasons. I had tried to create a function using built-in methods, such as `document.clear`, that would draw on the blank document defined by blank

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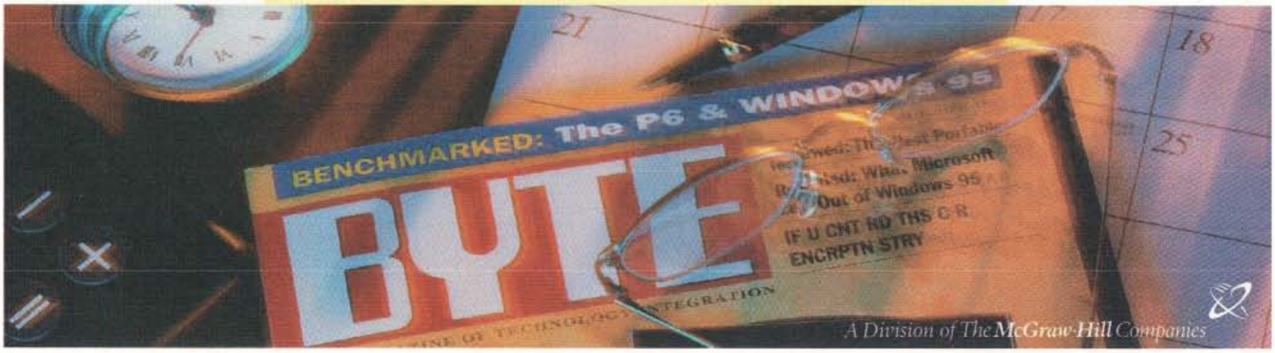
∇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.htm. But as I mentioned earlier, `document.clear` doesn't work as advertised, so I couldn't get this to work properly.

The answer was to use the history object. Each frame in a window has a history object, which stores the URLs of all the pages that have been displayed in that frame. Using the `history.go` method, you can tell a frame which page in its history list to display.

By using a value of zero as the argument to `history.go`, you tell the frame to reload the current document. In my case, reloading blank.htm into the menu frame causes the `CallBack` function to be called again. It can then check to see the status of the BYTECompass window—and from that determine whether to print a "Show BYTECompass" or "Hide BYTECompass" label on the button.

When you close the BYTECompass window, it notifies the parent document, which updates the Show/Hide button. The `onUnload` event is the trigger that tells the BYTECompass window that it's been closed. I use the `onUnload` event to run the `ImDead` function (see the listing "The Self-Destruct Function" below).

The `onUnload` event is one of the built-in events, and of course there's a matching `onLoad` event. It's important to realize that `onLoad` and `onUnload` are associated only with body and frameset tags. In other words, you can't have a table object that uses the event. However, it's easy enough to have the body object use the `onUnload` event to perform some task for the table object.

The `ImDead` function has a couple of statements to check whether certain objects are non-null. There are two possibilities: You've either closed the BYTECompass window directly or moved the main browser window off the byte_js.htm page.

If the BYTECompass window has been closed directly, it nulls out the handle to itself (it appears as if the `window.close()` method doesn't do this automatically, so I included the code to do it in my function), and it then uses the history object of the menu frame to force a reload. The menu frame then updates the menu button with the correct label.

Main Frameset

```
<frameset rows="10%,*" onUnload="KillCompass();">
  <frame src="/blank.htm" name="menu" scrolling="auto"
    marginwidth=8 marginheight=8>
  <frame src="http://www.byte.com/" name="art"
    scrolling="auto" marginwidth=0 marginheight=0>
</frameset>
```

The frameset points to an HTML page with a single JavaScript statement that invokes the callback function in the parent document.

The Self-Destruct Function

```
function ImDead() {
  if (rootWin.parent != null) {
    rootWin.parent.BYTECompass = null;
    if (rootWin.parent.menu != null)
      { rootWin.parent.menu.history.go(0);
  };
}
```

The ImDead function in the BYTECompass uses a couple of statements to check for non-null objects.

But if the user has moved off the byte _js.htm page, the `KillCompass` function in byte_js.htm forces the BYTECompass window to close. As it closes, there's an `onUnload` event that will, as in the previous case, call the `ImDead` function. But if `ImDead` then tries to manipulate objects in the parent window, they no longer exist and you'll get error messages. Thus, the `if` statements are *protective*—they make sure there are objects to manipulate before trying to manipulate them.

Tips and Tricks

There are a couple of nifty tricks I stumbled upon as I was playing with JavaScript. First, it can get difficult at times to figure out which built-in object you should be using, especially since there are so many aliases for so many objects. So, it's useful to dump out the properties of an object and see what's going on:

```
var info;
for (var i in obj)
  {info += i + " = "
  + obj[i] + "\n"; };
```

I apologize about all the semicolons—some of them are extraneous, but I just put them in to be safe. Anyway, this will iterate over an object and return a string with all the properties. I then use a little function window to print this as preformatted HTML to a trace window.

The other trick is hidden frames. If you use a frameset such as `<frameset rows ="10%, 90%, *">`, the third and final frame will not actually be displayed on the browser. It *is* there—if you move your mouse over the bottom of the display window, it should turn into a double-headed arrow. This will let you grab the border and lift it so you can actually see the third frame.

So why would you want a hidden frame? I've sometimes used this hidden frame as a way to attach code, such as my trace/debug functions, to a page. Then when the page finally works, I simply alter the frameset to remove the hidden page. You can also use this as a way to preload graphics in the background.

The more I've used JavaScript, the less enamored with it I've become. I spent several years as an Ada programmer; say what you will about the language, but if the *Language Reference Manual* (LRM) says that Ada behaves a certain way, then, by God, it *always* behaves that way.

The same cannot be said of the JavaScript documentation from Netscape. Call me old-fashioned, but I expect a vendor's own documentation to at least be correct, and ideally complete as well. If you can't get a feature like `document.clear()` to work, then remove it from the documentation so people won't try to use it. **B**

For the past year, technical editor Rex Baldazo has worked with BYTE's New Media group to help develop The BYTE Site. He recently moved to the reviews department. He can be reached at **rbaldazo@bix.com**.

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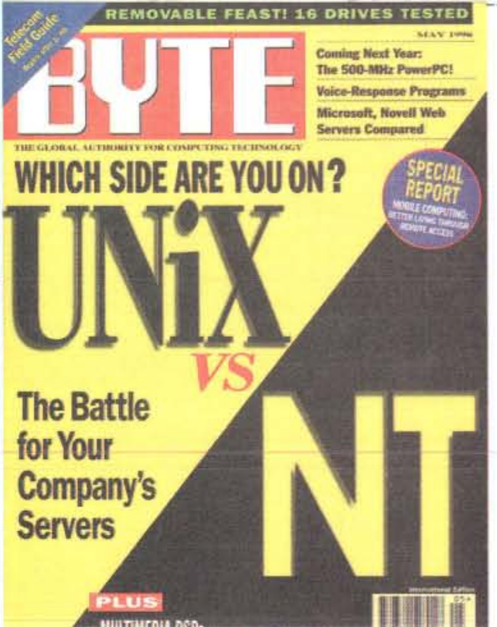
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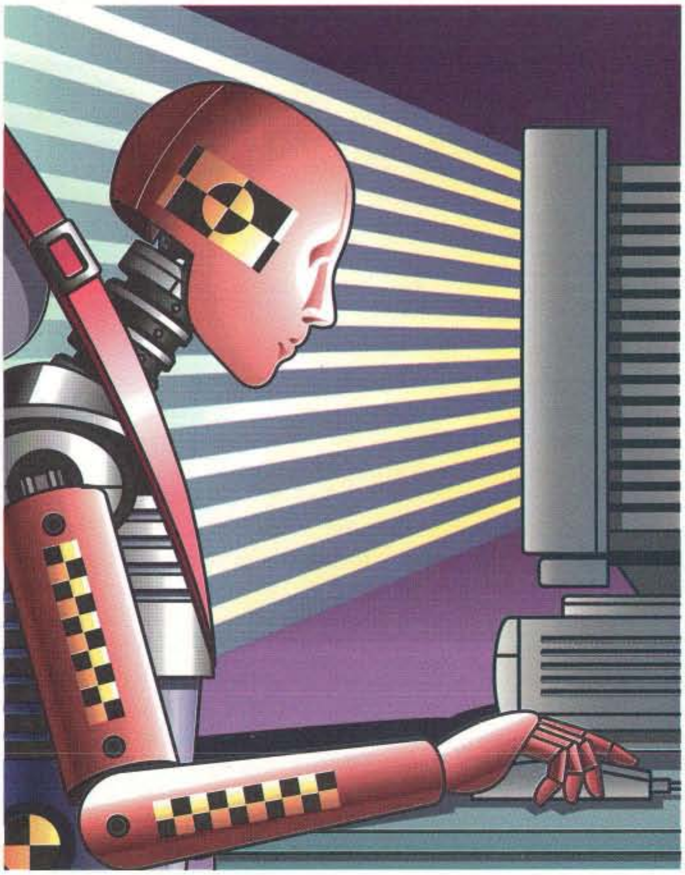
Beyond Benchmarketing

Finding the right benchmark test and interpreting the results isn't as straightforward as it seems.

By Rich Grace

"Gee, I get a Norton SI of 200 and 15,000 Dhrystones. Why are my Windows screen updates so slow?" If you've had this experience, you already know that computer benchmarking is an inexact science. But that doesn't mean it's worthless. You can potentially save thousands of dollars and hundreds of hours by basing a critical decision on properly interpreted benchmark results. The trick is telling the difference between benchmarking and benchmarketing.



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It's not exactly unheard of for vendors to provide misleading or exaggerated benchmark results. Sometimes it's an honest mistake. In other cases, vendors deliberately modify their products to fool popular benchmark tests. That's why the key to interpreting benchmarks isn't just to glance at the results. It's not the results that really count—it's how the tester obtained those results.

You also have to understand what a particular benchmark is actually testing, and what things are beyond its ability to measure. It's precisely these tedious but crucial details that marketing managers leave out of their cheerful advertisements and sales sheets. By themselves, raw numbers miss the point and provide much less insight than many people think.

But used correctly, benchmarks can help you make the right decisions when buying computer equipment. And they can help you fine-tune your system once you have it running.

At their best, benchmark programs can provide the following information:

- Realistic estimates of raw performance
- Potential performance when running a mix of real-world applications
- A specific subsystem's contribution to overall performance
- Whether a system will "break" or crash when processing heavy workloads
- The performance of very large systems that would otherwise be impractical to test or predict.

Compiler Tricks

Benchmarking is an incredibly diverse field. You can download some benchmark programs from the Internet for free and run them on your PC in a few minutes, while others cost tens of thousands of dollars and require the efforts of an entire MIS department to run successfully.

You can't always judge a benchmark test by the slickness of its packaging. Some of the most important ones don't come on a neatly shrink-wrapped, ready-to-run disk. For instance, to run the Standard Performance Evaluation Corporation (SPEC) benchmarks or Neal Nelson's Business Benchmark, you must compile a sprawling mass of source code into executable programs targeted for your computer. To some extent, therefore, these benchmarks test the efficiency of the compiler as well as the system.

Benchmark programs supplied as source code are vulnerable to exploitation because optimizing compilers that extract every ounce of performance from a CPU can show blazing results that are out of line with real-world applications. For example, some vendors have accused Intel of exaggerating the performance of its microprocessors by compiling the SPEC92 programs with heavy optimizations. That's one reason the new SPEC95 tests enforce tighter restrictions on compiler optimizations. When you're evaluating the results of a benchmark that's available in source code, be sure to find out if the compiler was typical of those used to build real applications on that platform, and ask how the code was optimized.

The SPEC benchmarks are a classic case of a widely known test that had to be scaled up in complexity and size to match the growth of today's systems. With the recent dramatic increases in processing power, some CPUs could execute SPEC92 programs in a matter of seconds, and the entire program sometimes fit inside the CPU's primary (level 1) instruction cache. This led to distorted results that didn't accurately represent real-world software.

With the new SPEC95, a complete run might require several days instead of several minutes. CINT95 and CFP95 (the SPEC consortium's new integer and floating-point processor tests, respectively) run on a much larger memory model than previous versions, requiring 64 MB of RAM for each test. (See "Bringing Benchmarks Up to SPEC," April BYTE.)

The baseline results, called SPECint_base95 and SPECfp_base95, are aggregate performance statistics with minimal compiler optimizations. The more widely quoted SPECint95 and SPECfp95 numbers are peak results that allow heavier optimizations. Although SPECint95 and SPECfp95 indicate the best possible performance you might get from a system or CPU, it's the baseline results you should pay attention to—especially if you're running off-the-shelf software that you didn't compile yourself. If a vendor won't provide SPECint_base95 and SPECfp_base95 results, you should be able to find them at SPEC's Web site.

SPECint95 and SPECfp95 peak numbers shouldn't be more than about 30 percent above the baseline numbers. If the spread is much wider, find out which compiler and optimization flags the vendor used. (SPEC requires vendors to report this information.) A wide spread between the baseline and peak numbers is a strong clue that off-the-shelf software probably won't deliver peak performance.

Also, be sure you understand what these tests are measuring. SPEC numbers indicate the raw computational power of the processor and its memory subsystem when running typical business and scientific computing tasks. CINT and CFP programs don't specifically measure such things as disk I/O, the speed of video redraws, or the performance of other subsystems. Different caching schemes (e.g., set-associative versus pipelined bursts) and different memory architectures can have a direct impact on results.

Bigger Benchmarks

To measure the performance of larger systems and servers, Neal Nelson's Business Benchmark and AIM's Suite VI and Suite VII programs offer two different approaches. Nelson focuses on government and large corporate users, and his unique programs run on everything from Pentium PCs to mainframes. AIM, meanwhile, tries to ensure the accuracy of its benchmark results by exercising an unusual degree of control over the testing procedures.

Nelson's benchmarks don't apply harmonic or geometric means to generate a single summary result. Instead, each of the 30 subsystem tests yields its own measurements, expressed as throughput under increasing load and degradation under increasing load. As the benchmark programs increase the load levels, they measure the response of the system against a reference computer (configured by Nelson) of comparable power. The results are quite easy to understand (see the graphic on the next page).

AIM rigorously controls its Suite VI and Suite VII benchmarks. You must purchase a job mix on an encrypted tape and load it onto your system. At that point, AIM uses a remote access program to take control of your machine and run the test. In this way, AIM monitors the system configuration and the benchmark reporting, effectively eliminating any shenanigans.

The Suite VI and Suite VII tests generate reports for each type of job mix. You can break down the results into three key numbers: peak performance, sustained performance, and job timing index. (These numbers apply to both workstations and multiuser systems.) The peak performance test simply measures the highest number of jobs per minute the computer can handle. The sustained performance number provides a more realistic estimate: It shows the highest level of performance a particular system can attain before it begins to suffer performance hits (such as an enforced pause before the system can service a process).

AIM's job timing index is crucial because it shows potential differences in the amount of time concurrent jobs take to complete. AIM likens this statistic to a hundred-yard dash. If 10 equally matched runners crossed a finish line at the same time, their job timing index would be 100. On a computer, this would mean that all equally balanced, concurrent tasks would take the same amount of time, which is desirable. If one task finishes behind the others, the index goes down. The closer a system's index is to 100, the better. It indicates the level of efficiency that users can expect to see during everyday use,

Benchmark Boo-Boos

The history of benchmarking is rife with political and technical squabbles, and sometimes outright cheating. Here are a few examples.

- **Fooling WinBench.** When the market for Windows video cards took off a few years ago, some vendors weren't happy with their WinBench results. With about 200 video cards on the market, manufacturers wanted their products to stand out. So a few of them embedded WinBench acceleration code directly in their ASICs or ROMs. This produced blazing benchmark scores, but provided no real benefit to users. Benchmark publisher Ziff-Davis was forced to change WinBench and go on the alert for similar tricks.
- **Intel's SPEC92 snafu.** Last January, Intel announced it had overstated the SPECint92 ratings for its Pentium and Pentium Pro microprocessors by an average of 10 percent. For example, Intel rated the 200-MHz Pentium Pro at 366 SPECint92 when the correct rating was 320.2. What happened? Intel compiled the SPEC92 benchmark programs with a beta version of an in-house C compiler. An error caused exaggerated results when running the 023.eqntott program. Within weeks, Intel issued correct results and noted that the error does not affect SPECfp92 or SPEC95 ratings.
- **BYTEmark gets bitten.** Late last year, BYTE discovered that its BYTEmark test sometimes reported inaccurate results. Lead developer Rick Grehan traced the problem to the way the C compiler's malloc( ) function allocated memory for arrays of 8-byte floating-point values. In some cases, malloc( ) returned a memory block that wasn't aligned on 8-byte boundaries. This turned out to be a problem when one routine in the benchmark program (a lower/upper decomposition algorithm) repeatedly accessed the nonaligned array. Because nonaligned memory accesses hit Intel x86 processors particularly hard, this led to lower-than-normal numbers for the Pentium Pro. BYTE fixed the problem by placing alignment wrapper code around malloc( ).

One Way to Chart Performance Degradation

Performance degrades when the number of concurrent tasks is large enough to overflow the disk cache in the two systems (see load factor 8 for machine 1 and load factor 9 for machine 2). The results also show that once the cache level is surpassed, the Solaris machine is from 150 to more than 300 percent faster than the NT system.

The number of tasks executing simultaneously

Compaq Proliant 4500 running Windows NT 3.51

Completion times

Compaq Proliant 4500 running Solaris 2.5

Load Factor	Machine 1 Avg Secs	Center column is percent difference. Arrows point to faster machine.	Machine 2 Avg Secs
1	2	<<<<<<<<<< 100	4
2	3	<<<<<< 66	5
3	4	<<<<<<< 75	7
4	5	<<<<<<<<<< 100	10
5	6	<<<<<<<<<< 100	12
6	8	<<<<<<<<<< 100	16
7	9	<<<<<<<<<<<<<<<<< 166	24
8	60	66 >>>>>>	36
9	158	8	145
10	385	151 >>>>>>>>>>>>>>>	153
11	531	212 >>>>>>>>>>>>>>>>>>>>>	170
12	710	281 >>>>>>>>>>>>>>>>>>>>>>>>>>>>	186
13	721	246 >>>>>>>>>>>>>>>>>>>>>>>>	208
14	951	311 >>>>>>>>>>>>>>>>>>>>>>>>>>>>	231
15	1049	311 >>>>>>>>>>>>>>>>>>>>>>>>>>>>	255
16	1183	338 >>>>>>>>>>>>>>>>>>>>>>>>>>>>	270

The Neal Nelson Benchmarks can identify performance degradation under increasing multitasking loads.

particularly under heavy loads. It's also a safeguard; AIM can employ the job timing index to detect any exaggerated results created by compiler optimizations.

Transaction Benchmarks

Raw processing power isn't the best measure of computer performance for all applications, which is why on-line transaction processing (OLTP) benchmarks are so important for evaluating client/server systems. There are two key points to keep in mind:

- OLTP systems rank among the most expensive computing investments in any enterprise, so you have a lot to gain from properly interpreted benchmarks.
- OLTP systems encompass almost every type of computer technology available, from mainframes to PCs to WANs. But you can't draw meaningful conclusions about overall performance merely by testing the individual elements of an OLTP system.

The Transaction Processing Performance Council (TPC) is the preeminent power in OLTP benchmarking. Its key program, TPC-C, has attracted its share of criticism but nevertheless remains the standard by which all other OLTP benchmarks are judged. TPC-C is so complex it takes an average of six worker months just to prepare it for a run.

TPC-C yields a critical statistic known as tpmC (transactions per minute). It balances the benchmark test's run time against the number of transactions the system executed during the run. If you notice how often DBMS developers quote tpmC statistics in their ads, you'll get an idea of how much it matters to them.

But look at the fine print. The system with the highest tpmC may also have a poorer price/performance ratio than other systems. If the ratios are fairly competitive (for example, $280/tpmC versus $300/tpmC), it doesn't matter too much. But if there's a huge gap in price for roughly comparable performance, you'll want to consider whether the difference is worth the cost for your application and whether it's worth paying alot more money for that extra speed.

Repeatable response times are a key requirement for OLTP systems. During a TPC-C test, the system must service 90 percent of all vital transactions in 5 seconds or less. If the system can't deliver that level of performance, the workload is too heavy and the tester must scale it down. Be sure to check for correct transaction structuring, proper scaling of databases, and complete documentation of results. A full TPC-C report can fill 150 pages.

PC Benchmarks

Ziff-Davis's WinStone and BAPCo's SYSmark allow people to test their PCs using the programs they're apt to actually use. A major difference between the two is that WinStone is free; BAPCo's latest offering for Windows NT costs $495 on a CD-ROM. (A Windows 95 version is in development.) SYSmarkNT is the first true 32-bit application benchmark for PCs.

SYSmarkNT's application mix is the same for systems based on Intel x86, Digital Alpha, Mips Rx000, and IBM/Motorola PowerPC processors. Administrators may finally be able to settle some arguments about whose system is the fastest when it comes to running common business software. Then it comes down to price/performance ratios and your intended application. Is it worth spending $15,000 on an Alpha workstation to run Microsoft Word and Excel a little faster?

Unlike the case with previous versions of SYSmark, you can run the NT version with any level of color depth and screen resolution, so you can mirror the way users really work on their computers. You can compare your system's composite results against those of the reference system, which is a 50-MHz 486 with 64 MB of RAM, an EISA video card, and a 1.2-GB SCSI hard drive. The baseline index for this system is 100.

Ziff-Davis's WinStone is exclusively for x86-based systems. Although it can run on Windows 3.1 and Windows 95, WinStone is a 16-bit benchmark that uses a mix of 13 major Windows applications in four categories: word processing, spreadsheet, business graphics, and database. Each category contributes to the WinStone composite score. (A 32-bit WinStone should be available by the time you read this.) Widely used by PC vendors, WinStone also has a propensity to crash systems that have the slightest compatibility problems, so it's a quick way to measure reliability.

Among PC benchmarks, perhaps the most abused is Ziff-Davis's WinBench and Graphics WinMark. The question "What's your WinMark?" has plagued trade-show exhibitors for the last five years. As we've already noted, basic num-

Benchmarks by Application

Benchmark	Best Application	Contact Info
AIM Suite VI	Tests Unix workstations. Reports peak and sustained performance in jobs/minute. Imaging, CAD, numerical analysis, and business applications tests.	**http://www.aim.com**
AIM Suite VII	Tests Unix servers; results in jobs/minute. Database, file server tests.	**http://www.aim.com**
BAPCo SYSmark	Applications test for PCs. Cross-platform. NT tests available now; Windows 95 version in development.	**http://www.bapco.com**
BYTE BYTEmark	Low-level tests designed to compare performance across hardware platforms. Reports scores using a 90-MHz Pentium as the baseline system.	**http://www.byte.com**
NSTL InterMark Suite	Combination of low-level and application-level tests. Cross-platform. Customizable.	**inmark@nstl.com**
Neal Nelson's Business Benchmark	30 subsystem tests to simulate multiuser, multitasking workloads. Includes context-switching, memory-access, and disk I/O tests.	**(312) 755-1000**
SPEC SPEC95 suite	CFP95 tests math and scientific functions; CINT focuses on engineering and midrange business tasks. The SPEC suite is centered on Unix; an NT version is due this summer.	**http://www.specbench.org**
TPC-C	For high-end transaction processing. Results reported in transactions/minute. Final result is measured against the total cost of the system being tested.	**http://www.tpc.org**
Ziff-Davis WinBench	For graphics, disk, and CD-ROM tests.	**http://www.pcmag.com/pclabs**

bers mean little. If you're testing a video card, you have to account for a wide array of variables, including the computer's CPU, the amount of RAM, and the size of the secondary CPU cache; the display's color depth, screen resolution, and refresh rate; the video card's RAMDAC and accelerator ASIC; and the number of Windows API calls that the card maker puts into silicon.

Always be suspicious of video card makers who report results without providing a complete description of the system's configuration. (Since WinBench provides more than 400 tests, reporting can be complex and demanding.) You can also consider the Graphics WinMark a good test of the stability of the video drivers for a display card.

BYTE's BYTEmark distinguishes itself from strict PC benchmarks like WinBench because it's written in ANSI C, so it's platform-independent. Although BYTEmark is considered a synthetic benchmark in the sense that it's not composed of real-world applications (such as BAPCo's SYSmark), it's based on algorithms widely found in popular engineering, multimedia, and business applications. All 10 programs in the BYTEmark suite report their results in terms of iterations per second, but their problem-solving nature sets them apart from the typical repetitive loops in smaller benchmark programs. Instead of repeatedly performing simple calculations, the BYTEmark programs use sample data to generate results that closely approximate the performance of real applications.

Currently, the BYTEmark baseline is a 90-MHz Pentium system, which has an adjusted score of 1. So if a system scores 1.5 on the BYTEmark scale, it's 50 percent faster than a Pentium-90. Since you can download the BYTEmark source code as well as the executables, you can create a BYTEmark executable with your preferred compiler on any platform. Of course, this also means that anyone can manipulate the results by using various optimization flags, so beware of vendor BYTEmark numbers that don't specify the compiler or the optimizations that were used.

Another cross-platform benchmark is NSTL's InterMark Suite. The suite includes low-level tests for subsystem and peripherals performance, as well as scripts that run standard business applications. You can also update and customize the suite with NSTL's plug-ins.

The Benchmark Treadmill

New applications for computers are cropping up all the time, and users need some way to compare the performance of different products and systems. For example, Web servers have different requirements than other types of servers, so tests that specifically measure the delivery of Web pages are inevitable. So are benchmarks that measure the performance of Java applets and applications in different run-time environments. BYTE will release a Java port of BYTEmark, designed to test performance of the Java run-time environment, by the time you read this. When Sun releases its Java processors next year, we'll need benchmarks to assess them, too.

There's no end to the technical and political debates over benchmarks. But the role of benchmarking in the decision-making process is secure.

Rich Grace is the author of The Benchmark Book *(Prentice-Hall, 1996). You can reach him at his Web site at* **http://www.rgrace.com.**

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Comparison

UltraSCSI Doubles Speed

High-performance mass storage rests on three legs: size, speed, and standards. As hard drive technology makes predictable but substantial gains in capacity and speed, SCSI standards adapt to keep up. Eventually, current parallel-bus SCSI will give way to emerging serial-bus SCSI standards such as Serial Storage Architecture (SSA) and Fibre Channel–Arbitrated Loop (FC-AL). Right now, however, UltraSCSI is the bus of choice for hooking hard drives to mainstream servers.

ADAPTEC

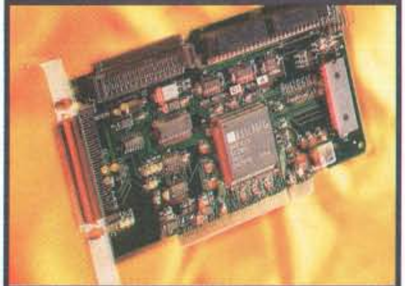
RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★
PERFORMANCE	★★★

The UltraSCSI host adapters we review here provide a bandwidth of 40 MBps, using wide 16-bit devices on a 20-MHz bus. We tested three commercial state-of-the-art PCI-based UltraSCSI host adapters from Adaptec, BusLogic, and QLogic. We also looked at an OEM card manufactured by Symbios Logic (see the text box "On the OEM Front" on page 130). Besides 40-MBps throughput, all the adapters feature drivers for DOS/Windows, Windows NT, NetWare, OS/2, and Unix.

Each adapter features both internal and external 68-pin connectors for wide devices as well as a single 50-pin internal connector for 8-bit devices. (For reliable operation, however, you can connect to only two of the three available connectors.) Thanks to jumperless configuration via ROM-based, menu-driven setup programs, physical installation is relatively simple. You plug the card into an available PCI slot and apply power to the system. The PCI slot must support bus-master transfers. Automatic termination is also a standard feature that worked well on each of the adapters we tested.

Narrow SCSI is an 8-bit-wide bus that supports up to eight devices, one of which is the host adapter. At any one time, only two devices on the bus can exchange data at a rate of 5 MBps. Wide SCSI increases the width of the bus to 16 bits, doubling the throughput to 10 MBps. Fast SCSI increases the bus clock to 10 MHz, raising throughput to 10 MBps for 8-bit devices and 20 MBps for 16-bit devices.

BUSLOGIC



RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★
PERFORMANCE	★★★

UltraSCSI represents a further doubling of the bus clock for data transfers to 20 MHz. (For compatibility reasons, SCSI commands themselves still clock at 1 MHz.) Like fast SCSI, UltraSCSI comes in both 8- and 16-bit flavors, also known as Fast-20 and Fast-40, respectively. There are also differential and dual-channel UltraSCSI cards. The cards we test here are 16-bit, single-channel, single-ended devices. Physically, an UltraSCSI host adapter can support up to 15 devices, including up to seven 8-bit narrow devices if you provide the appropriate connectors. For wide UltraSCSI devices, the limit is currently eight.

QLOGIC

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★
PERFORMANCE	★★★

Adaptec AHA-2940 Ultra Wide **BYTE BEST**

ADVANTAGES

- + Full SCSI ID range
- + Comprehensive documentation
- + EZ-SCSI and Corel bundled software

DISADVANTAGES

- - NetWare setup needlessly complex
- - Ultra speed disabled by default

The Adaptec AHA-2940 Ultra Wide ships with an extensive array of software and excellent documentation. Like the other cards we tested, it's a good performer. On the downside, we found setup and use unnecessarily technical.

Wide UltraSCSI host-adapter cards double your bandwidth to 40 MBps. ***By Robert L. Hummel***

By default, the 2940 Ultra Wide is configured as SCSI ID 7, the highest priority on the SCSI bus (see the Tech Focus). The card also supports the SCSI specification in its ordering of SCSI ID priorities (7–0 have higher priority than 15–8). Adaptec indicates that the card supports the SCSI Configured Automatically (SCAM) protocol to automatically assign SCSI IDs to compatible devices, but it disables this option by default. We did not test SCAM.

The 2940 Ultra Wide includes the ROM-based, menu-driven SCSISelect configuration utility with which you configure the card and run utilities to perform a surface scan or format on your SCSI disks. The card's default configuration enables support for wide devices but disables support for fast UltraSCSI bus speeds. To take advantage of full 40-MBps wide UltraSCSI bandwidth, you must manually set this option. Adaptec's assumption is that users will be attaching older SCSI devices.

Adaptec supplies the card with the complete set of drivers for its 7800 family of adapters, which includes the 2940 Ultra Wide. Installation of the drivers for NetWare 3.1x was straightforward except for one annoying aspect. To uniquely identify one of possibly multiple SCSI adapters installed in a system, you must manually calculate a slot number to provide as an argument to Adaptec's NetWare driver. The description of the procedure takes over a page in the user's manual, involves several sessions of hexadecimal-to-decimal conversion, and requires you to edit your STARTUP.NCF file after installation.

This procedure makes using the 2940 Ultra Wide needlessly complex and error-prone. Because the setup program knows the required information, the amount of additional code required for it to perform the slot-number calculation and display the result clearly on the setup screen would be trivial. Forcing you to perform this exercise even when installing a single host adapter is inexcusable.

BusLogic FlashPoint LW

ADVANTAGES

+ Marginally better performance

DISADVANTAGES

- Awkward setup program
- Host ID greater than 7 not supported
- No 800-number technical support

BusLogic (now a division of Mylex) ships its FlashPoint LW card with driver support for a wide variety of OSes. The card performed similarly to the others, but several quirks in its setup and operation made configuration range from difficult to nearly impossible.

Like the other host adapters, the FlashPoint LW comes configured as SCSI ID 7 by default. However, unlike other true 16-bit SCSI devices, which you can set to any ID from 0 to 15, it is impossible to configure the FlashPoint LW for SCSI IDs greater than 7. A call to BusLogic's technical-support line did not produce an explanation of this limitation or a description of the proper priority relationship between UltraSCSI IDs.

AutoSCSI, the FlashPoint LW's ROM-based, menu-driven configuration utility, was difficult to use efficiently. You must manually enable support for 40-MBps wide UltraSCSI speed, for example. And to do so, you must forge your way through no fewer than five menu levels. After making any changes for a single device, AutoSCSI requires that you back out of the menu system before you can save them. Switching to another device using PageUp or PageDown while in the View/Modify Device Configuration window, as prompted by the menu screen, discards all changes you've made for the current device—without warning. You must configure each device individually in this tedious manner.

continued

TECH FOCUS SCSI IDS

Setting Priorities

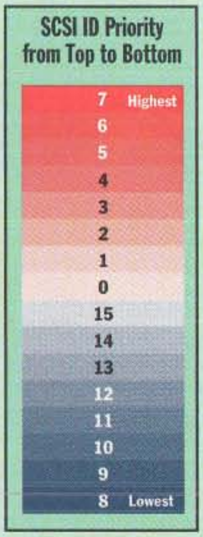
The UltraSCSI specification lets you attach up to 16 devices to a single cable, though currently you can put only eight 16-bit-wide UltraSCSI drives on a bus. You must also set each device with a unique SCSI ID (0–15). Because they share a single data channel, however, only one device can take charge of the bus at a time. When two SCSI devices vie for control of the bus, their SCSI IDs determine who wins according to a priority scheme.

The highest-priority ID on the SCSI bus is 7. You normally assign this ID to the host adapter. Next in priority, from highest to lowest, are IDs 6–0 and then 15–8. (For 32-bit SCSI devices, though none are yet available, IDs continue to decrease in priority from 23–16 and then 31–24.)

The justification for this odd sequence is backward-compatibility between older narrow (8-bit) and newer wide (16-bit) SCSI devices. SCSI devices signal on the appropriately numbered data line to assert their ID, which is why an 8-bit bus supports only eight devices. Because IDs greater than 7 are invisible to narrow-SCSI devices, all devices with IDs greater than 7 must yield to ensure that a conflict doesn't occur on the bus.

Although it provides backward-compatibility, this priority scheme can have a negative impact on overall system performance. Narrow—and therefore slower—devices, because of their lower ID numbers, will automatically preempt use of the bus by faster wide devices with addresses greater than 7.

SCSI ID Priority from Top to Bottom



QLogic Fast SCSI PCI Ultra-W

ADVANTAGES

+ Full SCSI ID range

+ Ultra speed enabled by default

DISADVANTAGES

- No SCAM support

QLogic's Fast SCSI PCI Ultra-W ships with a full range of drivers, and its straightforward configuration program made setup easy. For out-of-the-box compatibility with older SCSI devices, the Fast SCSI PCI Ultra-W comes configured as SCSI ID 7 but supports the full range of 16-bit SCSI IDs. The documentation gives no information relating SCSI ID to bus priority. This adapter does not support SCAM.

The QLogic card has the standard fast SCSI cable limits of 9.8 feet (3 meters) for four or fewer UltraSCSI devices and 4.9 feet (1.5 meters) for five or more UltraSCSI devices. Curiously, the installation guide provides no upper limit for the number of supported UltraSCSI drives

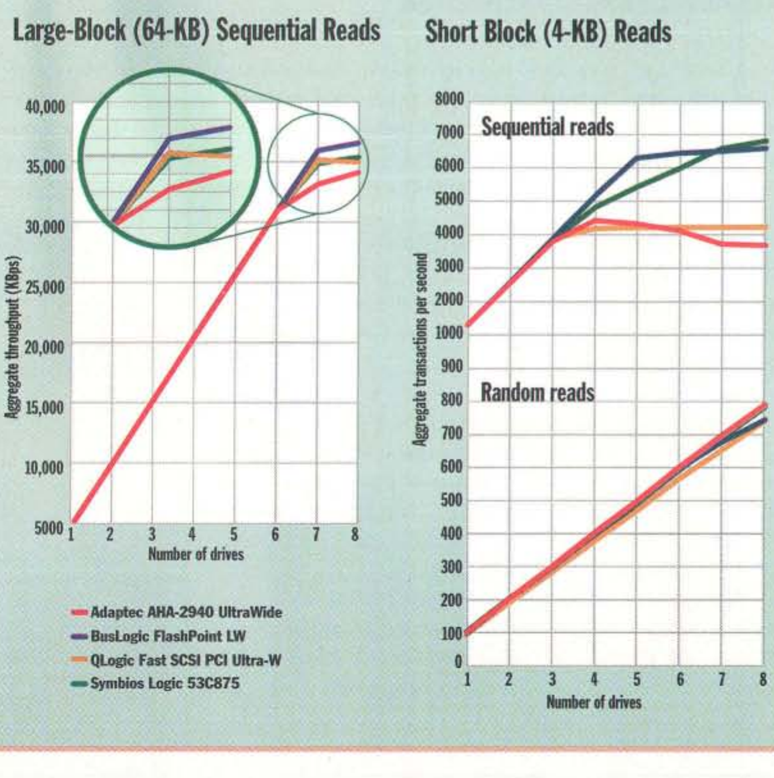
The Fast SCSI PCI Ultra-W's ROM-based setup program, Fast Util, saves time by setting the default value of all options to produce maximum performance with UltraSCSI devices. The installation guide lacks any screen shots of the setup program, however, to orient you when describing the available options. We also found some discrepancies in the default settings that are reported in the installation guide.

Driving Performance

To evaluate each adapter's ability to deliver data, we equipped a 133-MHz Gateway Pentium PCI system with 64 MB of RAM and Novell's NetWare 3.12 server software. (Testing under NetWare 4.01 gave essentially identical results.) A custom 1.5-meter UltraSCSI cable attached an eight-drive array of 2-GB Seagate ST32155W Hawk UltraSCSI hard drives to the test card's 68-pin internal SCSI connector. The first seven of these drives were assigned SCSI IDs 0–6. The eighth drive received SCSI ID 8. Host-adapter IDs were left at their default value of 7. This arrangement assigns the host adapter the highest priority on the SCSI bus, according to the SCSI specification (see the Tech Focus).

UltraSCSI Performance

With large-block sequential I/O, the wide UltraSCSI bus saturates at around 35 MBps.



Large-Block (64-KB) Sequential Reads

Short Block (4-KB) Reads

We used Symbios Logic's IOBench SCSI benchmark program (the IODTest portion) to measure the performance of the host adapters. Although IOBench is a NetWare loadable module (NLM), it doesn't run across a network, and IODTest avoids use of the NetWare file system. As a result, limits of the network topology or file-system cache did not impact the results. IOBench ignores any partition information on the drives being tested. We set the maximum number of outstanding requests per drive to 10.

Our test matrix consisted of 12 configurations generated by changing the read/write mix (all writes, all reads, or half-and-half), size of the I/O request (4- or 64-KB blocks), and using sequential or random access. We tested each configuration once while varying the number of drives from one to eight.

Bus Saturation

Though we didn't expect to achieve the theoretical maximum UltraSCSI throughput of 40 MBps, we did get 36-MBps aggregate throughput under the ideal conditions of reading (or writing) the drive sequentially with large, contiguous 64-KB blocks (see the performance graph). Each of the UltraSCSI drives in our test setup can exchange data at about 5100 KBps under these conditions. Eight drives could potentially deliver just over 40 MBps.

For combinations of one through six drives, all the adapters turned in comparable performances, and throughput on the SCSI bus increased linearly by about 5100 KBps per drive, as expected. Output from the FlashPoint LW increased linearly when we added a seventh drive. The remaining three adapters, however, began to show signs of bandwidth saturation, dropping the average output per drive by between 2 percent and 4 percent. Adding the eighth drive to the bus caused the throughput to level off for all adapters, indicating that the bus was operating at its maximum capacity.

Large-block sequential writes (not shown) provided slightly less throughput than reads. Aggregate throughput writing eight drives was around 1000 KBps less with writes.

With small-block transfers, the ultimate data transfer rate across a SCSI bus can be limited by the inability of the host adapter to process enough I/O requests in a timely manner. With random I/O, transactions per second scaled up linearly as we added

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Circle 163 on Inquiry Card.

On the OEM Front

Integration is the watchword for today's computers. New system cards routinely include built-in interfaces for floppy and IDE drives and networking. With increasing frequency, built-in SCSI is showing up as standard equipment on high-end system boards. To ascertain how well these systems will perform, we examined a prototype PCI host adapter from Symbios Logic (Fort Collins, CO, (719) 536-3300, http://www.symbios.com).

The card is based on Symbios's 53C875 UltraSCSI chip (shown above), which is likely to show up on system boards and host adapters from its OEM customers, since it is backward-compatible with Symbios's popular 53C825 fast SCSI PCI chip. The 53C875 is compliant with PCI 2.1 and ANSI's SCSI-3 UltraSCSI standard. Its 536-byte buffer allows efficient bursts on the PCI bus of up to 128 transfers. The chip also allows host-adapter designs that can work in both 3.3- and 5-V PCI slots. In all our performance tests, the Symbios wide UltraSCSI host adapter performed as well or better than the three brand-name adapters we examined.

drives to the test (both reads and writes), showing that the drives themselves limited performance, not the bus or host adapter. When hamstrung by neither bus-bandwidth or I/O-processing limitations, all four adapters were capable and turned in roughly equivalent performance.

When we configured IOBench to read data sequentially in 4-KB (eight-sector) units, something more interesting happened due to the cards' differing abilities to concatenate sequential I/O requests into larger extents. When reading from one, two, or three drives simultaneously, all four adapters gave comparable performances, and the number of I/Os processed per second increased linearly by about 1280 I/Os per second per drive. (The SCSI bus is not processing nearly as many I/Os per second as the test indicates because of concatenation.) When we added the fourth drive, differences between the adapters became obvious.

PRODUCT INFORMATION

AHA-2940 Ultra Wide $375
(kit with cables, drivers, and EZ-SCSI software)
Adaptec, Inc.
Milpitas, CA
(800) 934-2766
(408) 945-8600
fax: (408) 262-2533
http://www.adaptec.com
Circle 1081 on Inquiry Card.

Fast SCSI PCI Ultra-W $349
(with drivers and Corel SCSI-2 software)
QLogic Corp.
Costa Mesa, CA
(800) 867-7274
(714) 438-2200
fax: (714) 668-6950
http://www.qlc.com
Circle 1082 on Inquiry Card.

FlashPoint LW $279
(kit with internal cables, drivers, and bundled software)
BusLogic, Inc.
Santa Clara, CA
(408) 492-9090
fax: (408) 492-1542
http://www.buslogic.com
Circle 1083 on Inquiry Card.

The total number of apparent I/Os per second processed by the Fast SCSI PCI Ultra-W leveled off at approximately 4200 I/Os per second for four drives. Adding more drives decreased the I/Os per drive, but the total I/Os processed by the adapter remained nearly constant. With the 2940 Ultra Wide, total processed I/Os per second increased slightly to a maximum of 4416 when we added the fourth drive. However, adding additional drives decreased aggregate processing to a low of 3670 I/Os per second for eight drives.

The FlashPoint LW distinguished itself in this configuration, showing a linear increase in the number of I/Os processed as we connected up to five drives. The processing rate leveled out when we added six or more drives, reaching a maximum of 6589 apparent I/Os per second for eight drives. The Symbios adapter also turned in good performance in this configuration, slowing down sooner but not leveling off. The total number of I/Os processed begins to flatten out when the eighth drive is added. Nonetheless, the Symbios adapter is the winner in this test by processing 6811 apparent I/Os per second.

The short-block sequential results probably represent I/O saturation as opposed to throughput saturation. Even though they're interesting, they do not have much application to real-world performance.

What to Buy

If your hard drive use involves the typical mix of reads and writes in a range of block sizes, you'll be hard-pressed to measure any practical performance difference between the host adapters tested here. Choosing the wide UltraSCSI adapter that's right for you should boil down to a combination of price, support, and compatibility with existing hardware. Here again, we're hard-pressed to make a decision. In all cases, we found setup software less than satisfactory for the tested adapters.

Ratings Discussion

Technology:

The UltraSCSI technology in these adapters is very good and advances the state of the art for SCSI adapters. It is not breakthrough technology. Instead, it's evolutionary.

Implementation:

The 2940 Ultra Wide has the most complete list of features: the full range of IDs, SCAM support, a complete driver collection, and ancillary software. We believe that this makes it the best implementation by a thin margin.

BusLogic's implementation was the poorest. The card's ROM-based setup program is poorly designed and difficult to use efficiently. The card claims to support SCAM and ships with a complete set of drivers, but no unessential software.

QLogic has the middle-of-the-road implementation, providing an adequate ROM-based setup program and the necessary drivers. Although QLogic supports IDs from 0 to 15, the version we tested does not support SCAM.

Performance:

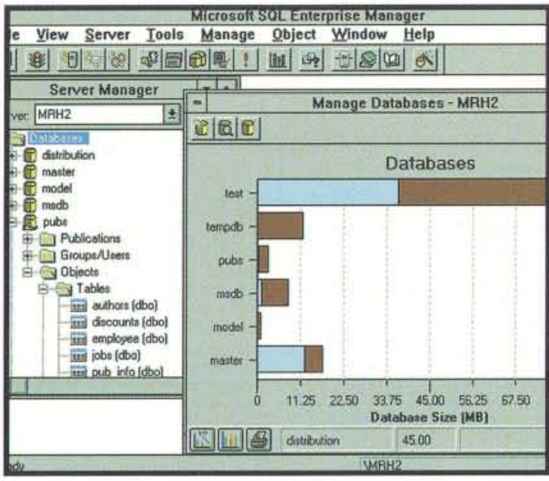
All adapters/drivers turned in approximately equal performance under the vast majority of circumstances. We believe that the differences that surfaced in a few cases of sequential IO, although interesting, would not have much application to real-world performance.

Adaptec's 2940 Ultra Wide includes the most complete list of features, but it also has the highest price. The lowest-priced card, BusLogic's FlashPoint LW, is feature-poor, while QLogic's Fast SCSI PCI Ultra-W is in the middle in terms of price and features. **B**

Robert L. Hummel is an electrical engineer, programmer, and consultant. You can reach him on the Internet at **rhummel@monad.net.**

Microsoft SQL Server 6.5 aims high—and usually hits the mark. By Mark Hettler

SQL Server: The Sequel's Better



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SQL Server 6.0, released last summer, marked the first distinctively Microsoft version of the database management product following the split with Sybase, the original developer. On the heels of that upgrade comes version 6.5.

SQL Server 6.5 has enough new features to warrant a 500-page manual. These include enhancements to its enterprise-wide data management capabilities, new tools for publishing data on the Internet, and features that extend the power of database procedures.

Managing Multiple Servers

Microsoft has taken heat for the cumbersome way SQL Server handles data changes on multiple servers. The process, called *two-phased commit*, is a mechanism for guaranteeing that changes to multiple servers are either all committed (permanently written) or all rolled back. In phase 1, the system ensures that all servers are ready to commit; in phase 2, the servers perform the commit. SQL Server required programmers to code the two phases, rather than the database system doing it automatically.

With a new feature in version 6.5, the Distributed Transaction Coordinator (DTC), users can simply execute Transact-SQL routines that update multiple servers within a transaction. The DTC works behind the scenes to track and coordinate changes. Alternatively, a DTC client utility allows applications to associate multiple-server SQL statements with a single distributed transaction. The advantage of this client utility is that it lets applications reference each server directly. In contrast, Transact-SQL routines execute on a single server, with references to other servers limited to remote stored procedures.

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

The DTC uses OLE to coordinate the servers involved in a transaction. Although SQL Server is the only resource manager with which the DTC can work, OLE will let Microsoft eventually support distributed transactions that incorporate multiple resource managers. (A resource manager is a program that manages the resources accessed in a transaction.) Each resource manager will be an OLE server, with the DTC functioning as an OLE client that uses OLE automation to control the server's behavior.

SQL Server's Enterprise Manager provides an intuitive point-and-click interface for setting up replication among multiple servers. Individual tables on a server are made available by "publishing" them; other servers then "subscribe" to a published table. Administrators can specify that changes should be replicated immediately after they happen or according to a schedule. Anyone who has dealt with the complexities of Sybase's Replication Server or Oracle's various replication options will appreciate the simplicity of Microsoft's approach.

New in version 6.5 is the ability to replicate to other databases besides SQL Server. This feature, called *heterogeneous replication*, uses Open Database Connectivity (ODBC) to transfer data from SQL Server to such databases as Access and Oracle. Because SQL Executive monitors changes to the data that is to be replicated and schedules the data transfers, replication in the other direction (from other databases to SQL Server) is not supported. You can't, for example, enter data into departmental Access databases and have SQL Server replicate the changes to a central location.

Internet Support

The Web Assistant that's included in SQL Server 6.5 is one of two tools introduced by Microsoft this year for producing Web pages that incorporate database contents. The other one is the Internet Database

Connector (IDC), part of Microsoft's separate Internet Information Server (IIS).

While the IDC runs on the Web server and "pulls" data from the database, the Web Assistant "pushes" data from the database to the Web. The Web Assistant has a wizard that lets Web-page designers enter selection criteria and formatting information; designers can also use templates similar to those the IDC uses. Although the resulting pages are static, rather than generated on the fly at run time as with the IDC, SQL Executive can regenerate them periodically, based either on a schedule or whenever the data changes.

OLE Automation via Stored Procedures

Microsoft has long recognized that, no matter how powerful a database's built-in language, some operations can be performed more efficiently by other programs. A previous release of SQL Server introduced external procedures, which let Transact-SQL routines call procedures in DLLs. In version 6.5, Microsoft has expanded on this concept by providing a set of predefined stored procedures to facilitate OLE automation. You can call these procedures in Transact-SQL routines to access OLE servers and execute their automation methods.

Developers can also write their own OLE-server programs for access from within SQL Server, extending functionality in much the same way as extended procedures. OLE automation is the centerpiece of Microsoft's strategy for applications partitioning. A large part of the Visual Basic 4.0 manual for developing client/server applications deals with transferring portions of an application's functionality to OLE-server programs running on a remote machine.

Having the option of performing OLE automation from within SQL Server rather than from client applications lets the automation routine be part of built-in validation procedures. For example, a credit check used to validate a purchase might require the use of an external application to dial into a remote location to check information.

Your Mileage May Vary

In our benchmarking (see the table in the text box "Making Book on SQL Server 6.5"), we found SQL Server 6.5 to be at least as fast as, and usually faster than, version 6.0, but you'll need to benchmark your own applications to get a more realistic measure of performance. Also, tuning the database, such as setting a table to be either row- or page-locked (see the Tech Focus), can affect your results.

There is room for additional improvement in version 6.5. The graphical interface for loading data, which disappeared in the upgrade from 4.2 to 6.0, needs to be put back, and the inability to modify existing columns in tables is a major inconvenience. However, SQL Server is still head and shoulders above the competition in usability, particularly in the intuitiveness of its administration tools. It's a solid upgrade. **B**

Mark Hettler is a senior technical editor at NSTL, McGraw-Hill's testing facility. You can reach him on the Internet at **markh@nstl.com**.

Making Book on SQL Server 6.5

To compare SQL Server 6.5's performance with that of version 6.0, we timed queries performed on a book-order-entry database with five tables, each with anywhere from 10,000 to 100,000 records at the start of the test. First, an order transaction queried for an ISBN number, executed a three-table join to find the author, and then repeated until five books had been looked up. Records to track the order were then inserted and the inventory updated. A payment transaction looked up an order record and updated it to indicate payment.

The simple-query version of the test looked for a range of orders, returning about 2000 records each time. The five-table join query searched for a range of 200 order numbers, listing the books in each order and the author of each book. With five books per order and two authors per book, the five-table test also produced a result set of about 2000 records.

The results shown below have been normalized, with SQL Server 6.0 results equal to 1. Higher is better.

SQL Server 6.5

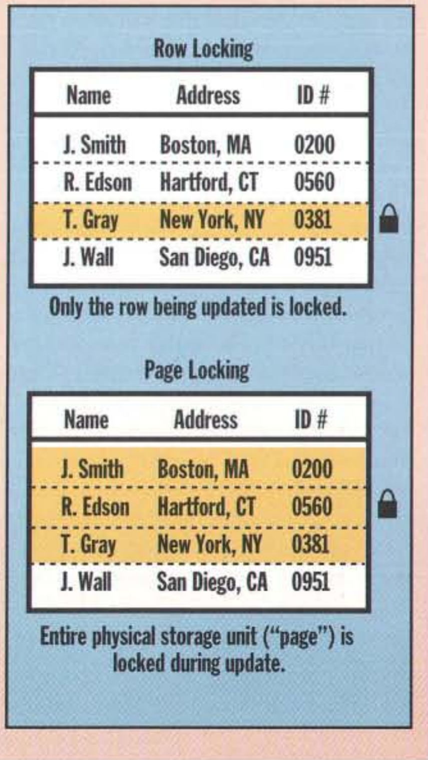
Order test (one user)	1.385
Order test (eight users)	1.106
Payment test (one user)	1.333
Payment test (eight users)	1.133
Simple-query	1.400
Five-table join query	1.417

TECH FOCUS | CONTENTION

Row Locking vs. Page Locking

New in Microsoft SQL Server 6.5 is the option to use row locking rather than page locking on insert operations. Locking mechanisms prevent users from changing data that another user has already changed, until the changes are committed. Row locking locks only the row that is being changed. Page locking locks an entire physical storage unit (2 KB in SQL Server), which may include unchanged records adjacent to the changed record.

Such fine granularity minimizes the possibility of lock contention and improves throughput. However, page locking has its own benefits: Locking larger storage units requires fewer locks to manage and reduces system overhead. For updates of records in large tables, locks will likely be spread over a large-enough area and held for short-enough durations to minimize the potential drawbacks of page locking. But when multiple users insert records into a table in sequential order, several consecutive records are likely to be targeted for the same page, resulting in serious bottlenecks.



Row Locking

Name	Address	ID #	
J. Smith	Boston, MA	0200	
R. Edson	Hartford, CT	0560	
T. Gray	New York, NY	0381	🔒
J. Wall	San Diego, CA	0951	

Only the row being updated is locked.

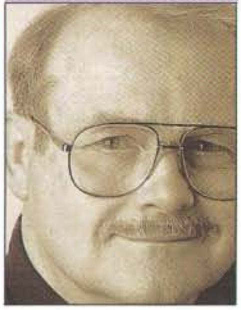
Page Locking

Name	Address	ID #	
J. Smith	Boston, MA	0200	
R. Edson	Hartford, CT	0560	🔒
T. Gray	New York, NY	0381	
J. Wall	San Diego, CA	0951	

Entire physical storage unit ("page") is locked during update.

Jerry Pournelle

Pournelle



Adieu, Pentafluge... Hello, Cyrus

Jerry breaks in a new Cyrix 6x86 machine and wrestles with Win 95's System Agent and the PCI bus.

PHOTOGRAPH: THEO FRIDLIZIUS © 1996

The Book of the Month is *Windows 95 Is Driving Me Crazy* by Kay Yarborough Nelson (Peachpit Press). I don't usually lead with a book, but Nelson answers questions I hadn't known to ask, as well as clearing up a number of puzzles, and her title is on target for what's been happening at Chaos Manor this month.

She doesn't answer all my questions, for instance, about the hesitations that send me up the wall. Every now and then, Windows 95 (Win 95) hangs up for a second. If I'm writing, I can type several characters before one will appear on-screen. Hunt-and-peck typists, who look at the keyboard, won't mind that, but it's unnerving to a touch-typist. A partial solution comes from reader Darwin Boyle, who dug through the Windows 95 Resources Kit to find things that Microsoft's technical experts didn't seem to know when I asked for help.

We've been testing the Cyrix for about a month now, and we've found two glitches.

Boyle suggests that I go into Network from the Control Panel, select File and Printer Sharing for Microsoft Networks, and hit Properties. Change the setting for LM Announce to No and set Browse Master to Disabled. This does help. It seems that on a Microsoft peer-to-peer network, the computer designated as the Browse Master periodically goes out to see what new machines have been added. This speeds up browsing, but it also brings the machine to its knees while it's doing it. With a fast-enough machine you may not see the hesitation, but with a Pentium 60 or slower it's noticeable.

Alas, while that fixed some of the problem, it didn't get it all. I still have short hesitations, perhaps not as bad or as often as before, but real enough. Kay Nelson suggests that periodically Win 95 likes to talk to the disk. While doing so, it hangs up the system; and there's nothing you can do about it. The problem with that explanation is that Pentafluge uses a Distributed Processing Technology caching controller with 16 MB of cache memory, so talking to the disk is or should be as fast as talking to memory.

I may never know why I get these hesitations because I'm about to change machines. Pentafluge is "only" a Pentium 60. That was state of the art when we built him, but it's way behind the curve now, even with the caching controller speeding up disk access. The machine is solid enough that I can attach a big SCSI string to it: the Pioneer DE-SH7101 read/write external optical drive in addition to the Maxoptix T3-1300 optical drive already built in, a Pioneer DRM-624X six-pack CD-ROM changer, and a good digital audiotape (DAT) drive.

The CD-ROMs I use most, especially Microsoft Bookshelf, the Oxford English Dictionary, and Grolier's Encyclopedia, reside on the DRM-624X. This is a triple-speed unit, which is a bit slow for multimedia, but it's good enough for text retrieval across an Ethernet. The only problem with the DRM-624X drive is that each CD-ROM has to be mapped as a separate drive letter.

What I really need is a system that sees the six-pack as one drive and then hunts until it finds the CD-ROM that I'm trying to access. I seem to remember that early Bureau of Electronic Publishing programs would seek through a series of drives, but that was long ago. Anyway, the notion is that Pentafluge will become a resource and backup server and go off to the cable room.

My new main machine will be Cyrus, a Cyrix 6x86-P166. Cyrus isn't quite the fastest machine in the house; that honor still belongs to the Intergraph TDZ-400, a dual Pentium Pro 150, which does graphics so fast it scares me. However, Cyrus is the fastest "ordinary" system I have.

It comes in a neat little tabletop tower that can sit right next to the monitor. There's a Matrox MGA Millennium video board—I currently recommend Matrox as the preferred video board—a Sound Blaster AWE32 card with a Cambridge Soundworks multimedia speaker system, 32 MB of memory, and a six-speed EIDE CD-ROM drive running off an Adaptec Ultra SCSI board. Cyrus came with a 17-inch CTX monitor, which is quite good. It has a steady image with no flicker and good color, but I'll replace it with my wonderful 21-inch ViewSonic Professional Series PT810. I'll also bring over my Northgate OmniKey keyboard.

We've been testing the Cyrix machine for just about a month now, and we've found two glitches. The first turns out to be endemic to all fast systems. We noticed that if they were left to themselves for a few hours, the machines would lock up. This happened to RacingCow, the Gateway 2000 P5-133XL, and then later to the Cyrix machine. Neither machine had the problem when we got it. The log showed that the problems developed just after we installed Windows 95 Plus. Great heavens, Holmes, a clue!

When you install Windows 95 Plus, the default is to install System Agent, a utility that waits for the system to be idle and then goes out and checks your hard disk and does other system cleanup things. If that's installed in a system with a "green-machine" CPU manager (not a screen saver, but a BIOS-level power manager) that puts your system to sleep after a set period of time, then sooner or later, System Agent and the "sleep" utility are going to collide. When they do, they'll lock up your system. It can happen during long installations or file transfers.

By coincidence, I had dinner tonight with a Corel team demonstrating the new Corel intranet videoconferencing system (excellent!), and they sometimes have mysterious problems with the IBM ThinkPads they carry for the networking demonstration. I noticed they had System Agent running during the demonstration.

A partial solution is to disable System Agent. This is no great loss, because System Agent does nothing that Norton System Doctor doesn't do better. I strongly recommend that if you're running Win 95, you install and run System Doctor. Unfortunately, while that will stop lockups when the system is simply sitting idle, it will *not* prevent the stupid power manager from putting your machine to sleep during long network file transfers or downloads.

Eventually, both System Agent and BIOS-level power managers will be written by people who *use* computers instead of theoreticians, and they'll check for file transfer and communications activities as well as keystrokes; but for now, you're safer turning both those silly things off and using a screen saver.

The Cyrix has run everything I have thrown at it, including DOS games running under Win 95.

Alas, Norton System Doctor is the other incompatibility I've found with Cyrus. There were two problems, both related to the great speed of the Cyrix 6x86-P166. One was amusing. When you shut the system down, the "IT IS NOW SAFE TO TURN YOUR COMPUTER OFF" message appears 2 seconds before Norton System Doctor is finished writing its backup information to disk. The result is that when you bring the system up the next time, it goes into safe mode. Shutting down from that lets the system come up naturally. The remedy is to count to five after the message appears.

The other problem—that the machine could lock up during a long, unattended download—is more serious and has no remedy other than not to run System Doctor. However, when I reported these problems, both Symantec and Cyrix were concerned enough that Cyrix shipped Symantec a system by Federal Express, and they got their software gurus on the case. I have no doubt that by the time you read this, you'll be able to run Norton System Doctor with the Cyrix. Stay tuned.

Those were the only glitches I had with Cyrus. Otherwise, it has run everything I have thrown at it, including DOS games running under Win 95. Two DOS games, Whiplash and ChronoMaster, wouldn't run properly on the Gateway 2000 P5-133XL as it was shipped, but they run just fine on the Cyrix right out of the box. For that matter, This Means War, which has

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Circle 159 on Inquiry Card (RESELLERS: 160).

managed to crash every system we've tried it on, runs faster and causes fewer problems on the Cyrix than any other system we tried it on.

I'll leave benchmarks and other systematic tests to BYTE's technical people, who can do it much better than I can. My bottom line is that the Cyrix 6x86-P166 with Win 95 is certainly fast enough for any application I have to run on it. I have enough confidence in its compatibility that next week I'll set it up as the main system here; my only real holdup is furniture, and that's just a minor problem. I'll have more next month, but I think Intel now has a serious competitor.

I'm having real problems getting PCI-bus network cards to work properly. That's independent of the machines: the problem is that the PCI bus wants to do one kind of Plug and Play management, and Win 95 wants to do another. The result can be sheer hell.

In theory, Win 95 should be able to find and recognize new hardware, assign it an unused interrupt request (IRQ) and addresses, and get everything running properly without intervention. In practice, it's a bit different.

First, many of the newer systems are pretty full. The Gateway 2000 P5-133XL came with a bus mouse, an internal modem, a sound card, and two serial ports. There was precisely one IRQ available for a network card. When we wanted to add a SCSI controller card, we had to disable one of the serial ports. Given we have both modem and bus mouse, that's no particular loss, but it turns out to be a bit tricky.

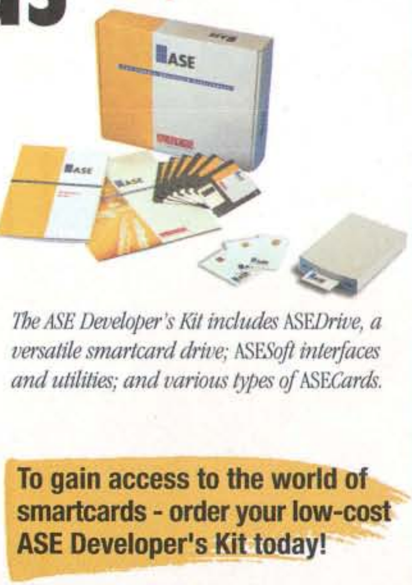
The first thing we do with a new machine is to get it on the network. I had a new Plug and Play Ultimate PCI-3000 Ethernet card from Applied Creative Technology. The Cyrix is billed as a Plug and Play machine. It seemed a fair test: insert the card and turn the machine on. It locked up to hardware reset. I took out the board, restarted, and tunneled down through Control Panel, System, to Device Manager, where I discovered that since the Cyrix came with a SCSI controller, every IRQ from 0 to 15 was in use by either the system itself or Win 95.

I'm having real problems getting PCI-bus network cards to work properly.

After the Ultimate PCI-3000 Ethernet card locked up the system, I took it out and inserted an Intel EtherExpress card on the ISA side of the bus. This time, Win 95 noticed the card, which happened to be addressed to IRQ 3. When I let Win 95 install the drivers for the card, it did so, automatically disabling COM2, which had been using IRQ 3, and all was well. Once I was sure the network worked properly with the Cyrix, I tried again to get the Ultimate PCI-3000 Ethernet card to work.

It wouldn't. The problem was that I needed to make the system set that card to IRQ 3—the only available interrupt—and it just didn't want to do it. Even putting the card into another machine and running software to force it to be IRQ 3 did not work, because as soon as it was put back, the PCI bus and Win 95 between them would reset it to something else. This isn't a Cyrix problem, nor is it the fault of the PCI card. We've had this difficulty on every PCI-bus machine that doesn't have several free interrupts.

There is a way to do it. What you must do is get into the Cyrix BIOS (press the Del key as it is booting up) and go into the menu item called Advanced Features; go



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from there to Integrated Peripherals. Disable COM2, which uses IRQ 3. Do a cold reboot—turn off the system—so that both the PCI management firmware and Win 95 know what you've done. Now you can insert your PCI-bus card, and both the PCI bus and Win 95 will know that IRQ 3 is available. Then, Plug and Play will take over, and things will proceed nicely.

I've just done that. Cyrix has a BIOS revision that frees up another interrupt. I downloaded that from the Cyrix BBS. The instructions said make a bootable floppy disk, which I did through Win 95's My Computer and the help screen; copy the BIOS revisions to the floppy disk; boot up with the floppy disk; and issue the command `Flash ecs.bin`. That took about 2 minutes. While the machine was turned off, I removed the EtherExpress card and turned on the machine. Win 95 reported that the network card wasn't working, which was hardly surprising, and then continued to boot. When it was done, I went into Device Manager and removed the Intel network card driver, turned off the machine, inserted the Ultimate PCI-3000 Ethernet card on the PCI bus, and turned on the machine.

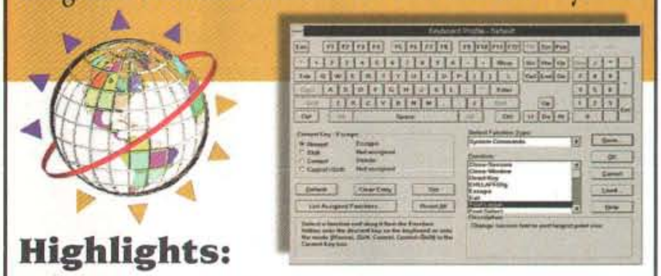
I was expecting the worst, but in fact the system came up, the network set itself up, and everything worked splendidly, all untouched by human hands. When Plug and Play is working properly, it *really* works painlessly. Of course, it doesn't always work properly.

Pournelle's law: when installing hardware, it's important to turn off the system, not just do a warm boot. Alex found this out trying to install a D-Link Ethernet PC Card in a Texas Instruments Extensa laptop. He used the new hardware feature of Win 95, but when the network came up, the CD-ROM drive wouldn't work. The remedy was to go into the Device Manager with fire and sword, deleting all drivers, including the PC Card-to-PCI bus bridge. Kill 'em all, God will know his own. Then turn off the machine. When it comes back on, it will notice that it has unrecognized hardware and look for drivers. "Aha! I have a CD-ROM drive! Aha! There's an Ethernet card!" Eventually, it will reload its drivers, and this time it will have both a CD-ROM drive and a network. No other procedure seems to work.

The PCI bus was supposed to solve all our compatibility problems, but instead it has created more. It's the same with Plug and Play, and the reason is the same in both cases: there's a lot of legacy hardware out there, and making provision for that to work involves compromises that can cripple modern stuff.

There's no way around the shortage of IRQs with present-generation equipment. SCSI tries, but it's very often one more way to make you crazy. You can reduce the danger of insanity when setting up SCSI strings by using Granite Digital SCSIVue Gold Diagnostic Cables. About half the trick to SCSI is getting the termination right, and 90 percent of what's left is being sure you

The PCI bus was supposed to solve all our compatibility problems, but instead it has created more.



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don't have cable problems. Granite Digital cables always work, and the blinking lights tell you right away if you've got termination and a good connection. If you often do SCSI, get Granite Digital cables.

The real remedy to the interrupt shortage will be the universal serial bus (USB). Unfortunately, this will take more than a new card; it's probably going to have to be built onto the motherboard. Then we'll need peripherals that can use it. When it's done, though, you'll be able to add digital video cameras, scanners, sound dictation systems, game controllers, and all kinds of stuff to your system without having to get inside the box and without going through the IRQ hell.

At least that's the way USB enthusiasts talk, and you can believe as much of it as you want to. I want to believe it all, but I do wonder if I haven't heard this song before....

Game enthusiasts, rejoice! You don't have to wait for USB to have multiplayer game controls. Advanced Gravis Computer Technology is shipping The Ultimate Team Sports Set. This is a hub that connects to the game port on your sound card (or your motherboard if you have that kind of machine). Install the software, and you can connect up a joystick and a pair of game controllers. Actually, you can run up to four controllers; I've tested it with only two because that's all I have.

These are the kind of two-hand game controllers all the kids use, with a round button that functions as a joystick for your left thumb, a bunch of buttons for the right, and triggers for both index fingers; they're guaranteed to have a steep learning curve for adults. There are several configurations, all "standard" in the sense that every game fanatic seems to understand them instantly. Once you've learned to use these controllers, you can play two-person games like Mortal Kombat; or you can use just one of them to really control an electronic pinball game.

That's the good news. The bad news is that most games, including the PC version of Mortal Kombat, aren't aware of the multiple joystick hub. Apparently, it wouldn't be hard to recompile two-person games that now use different parts of the keyboard to control the action to make use of this system, but I don't know how many companies will actually do it.

This will become obsolete when we get USB. With USB, you could have half a dozen game controllers connected to the same system. And then someone can write a multiplayer version of Doom....

It isn't often that I get a program so complex that I can't even list all its features, much less describe them; but Wall Street Analyst 2-CD from Omega Research has managed it. This probably isn't the ultimate in stock-charting and analysis software, but it's not likely that anyone but a mathematician will want anything more; and there's no guarantee that a mathematician can get better results.

There are two approaches to stock-market investments. Brokers have their own terminology, but I call them "real-world factors" and "trend analysis." Real-world factors include what the company makes, how efficient it is at making and selling it, and factors that influence supply and demand, for example, weather and climate.

Some brokers call the other method "technical factor analysis." It's a system based on predicting the future by analyzing the past, and in its pure form, what the company makes or whether it makes anything at all, is irrelevant. The important

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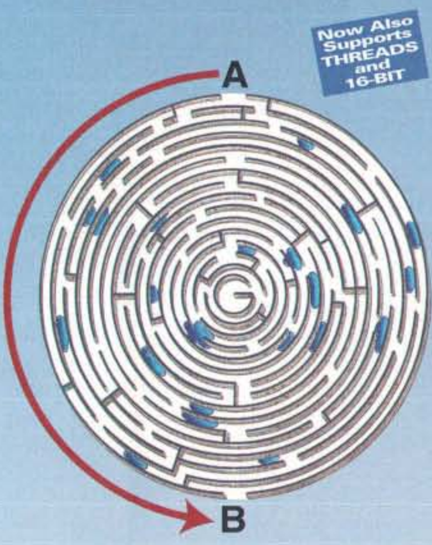
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things are ratio and trend lines. In the old days before computers became common, this was done by drawing lines on charts of the stock's past history and trying to extrapolate trend lines into the future. There were all kinds of rules of thumb having to do with the technical factors of the market, such as the ratio of railroad stocks to industrials. It all sounded very complicated, but it wasn't, and you could learn most of the technical theory in a week.

Then in World War II, military-operations research people developed all kinds of mathematical techniques for predicting the future based on a chart of the past. The intention was to develop ways to predict where an airplane would be at the time an antiaircraft shell could get to an interception point, and the problem was sufficiently complex that some of the first high-speed computers were developed to solve the equations in time to do any good. It wasn't too long, though, before market analysts got interested in the same techniques, and thus was born a new era in market analysis.

The new theories also spawned some science fiction clichés, such as the boy with the computer who is able to manipulate the market and end up owning the earth. The author of that story didn't consider what might happen if everyone on Wall Street also had a computer.

That is the situation today, and since many of the technical analysts use the same techniques and often the same analytical software, it's hard to get much of an edge by doing market trend analysis. It's even harder to get an edge you can act on in time to do you any good; after all, many of your opponents have a direct wire to a floor trader, and they'll get their orders in while you're trying to call your broker.

If, after you've thought about that, you still want to try your hand at technical market analysis, the best bet I know of is to get Wall Street Analyst 2-CD and spend some time with it. Spend enough time, and you'll know quite a lot about the subject. All the analytical tools are in the package, and the instructions, while sometimes tedious, are complete. You'll learn about buy and sell factors, and you can call on the built-in expert systems to check your work. There's other software that will watch for trends and alert you when buy or sell conditions have been met. You'll learn about support and resistance lines, and all the other technical stuff that fascinates Wall Street analysts.

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Wall Street Analyst 2-CD is the best and easiest-to-use technical market-analysis program I have seen. They have really worked at it. The CD-ROM version gives you the complete stock history of a large number of companies, including Microsoft and Apple. It's fun to superimpose their charts. Then you can add IBM and finish by looking at the trends for a fertilizer company. The result should be instructive. Highly recommended as software.

The game of the month is SSI's Fantasy General. This is a tactical-level game with a long story scenario. It's turn-based, so you have plenty of time to decide how to proceed. I found it restful after some of the more frantic real-time war games. It's not quite as addictive as This Means War, but for compensation, there's no random sabotage factor, and while it will crash when run under Win 95, it doesn't do that often. Each episode of the game takes under an hour, but there are a *lot* of episodes. I haven't finished it yet, but I intend to.

A good companion to *Windows 95 Is Driving Me Crazy* by Kay Nelson is *Optimizing Windows 95* by Lenny Bailes (Osborne-McGraw-Hill). This is more for reference than light reading, and unfortunately they chose to go with more pages of text instead of a better index and an analytical table of contents; meaning that there's more in it, but finding what's there can be difficult. It's still well worth having.

The book of the month is *Expiration Date* by Tim Powers (Tor Books). It's a typical Powers story: well-researched details of a world that you'd swear is modern Los Angeles, but it clearly isn't, since in the first chapter the protagonist finds a vial containing the ghost of Thomas Alva Edison. I don't think you'll be bored.

The CD-ROM of the month is Critical Mass: America's Race to Build the Atomic Bomb, from Corbis. This is a well-done history of how the atomic bomb was developed. It also includes lessons in the basic science involved. Of necessity, it emphasizes some of the Los Alamos people while ignoring others, but the selections have been done reasonably well.

Corbis is "Bill Gates's other company"; like all Corbis products, this one is slick and easy to use. It has a sophisticated interface. There's one problem: it will *not* run on a networked CD-ROM drive. The disk has to be in a drive native to the machine running it. That may be a problem for educational institutions.

As usual, you can find more of this column on the BYTE Web site. You might also want to check out http://www.earthlink.net/discontinuity, where John C. Dvorak and I argue critical issues. B

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com.**

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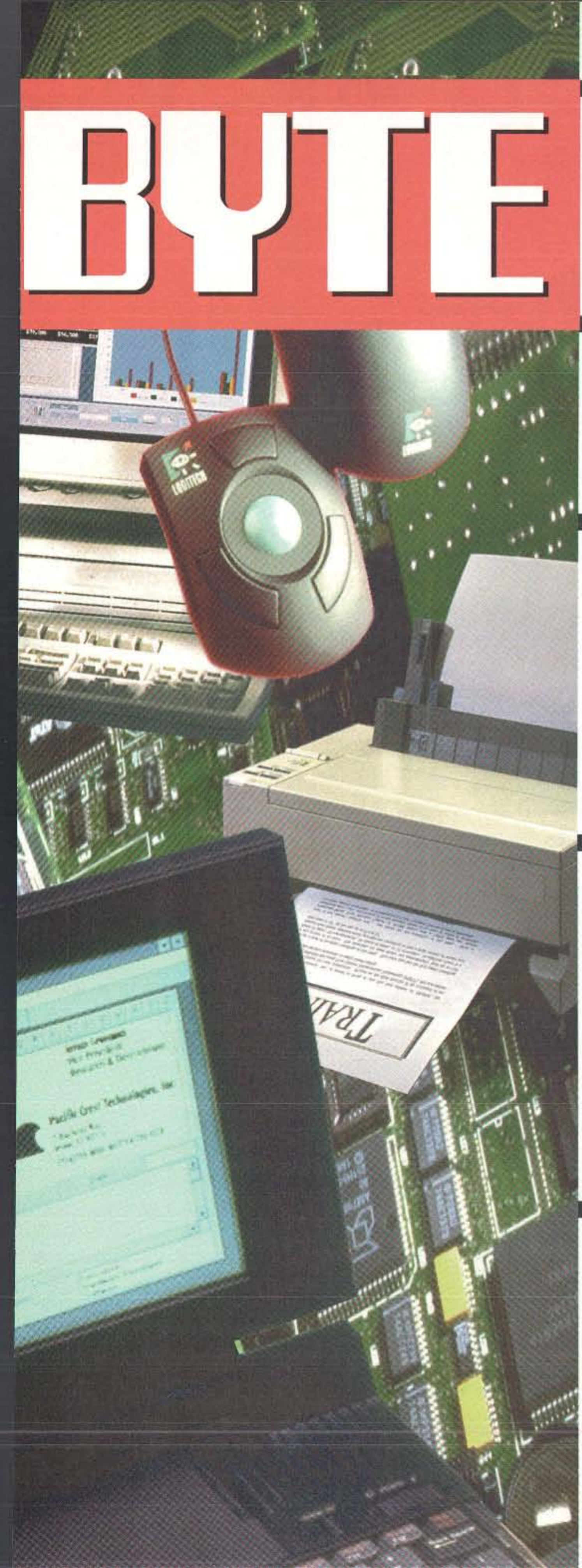

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LTE 5300 5/133 16MB 1.3GB 12.1" active	5761.87

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ProLinea 5150 MT 5/150 16MB 2GB	2491.65
ProLinea 5166 MT 5/166 16MB 2GB	2706.35

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Deskpro 5100 5/100 16MB 1.2GB	1824.95
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Deskpro 5133 5/133 16MB 2GB 4X CD	2632.90
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Versa 2200C 5/75 8MB 810MB 9.5" active	2449.00
Versa 4050H 5/90 8MB 810MB 10.4" active	4099.00
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2.0GB Fast-ATA	291.47

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Promise EIDEMAX ISA 2HD on-board BIOS	25.81

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ACCURA 288 V.34 external w/fax	168.69
OPTIMA 288 V.34 internal w/fax	359.58
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IBM ThinkPad 760 series 8MB	247.99
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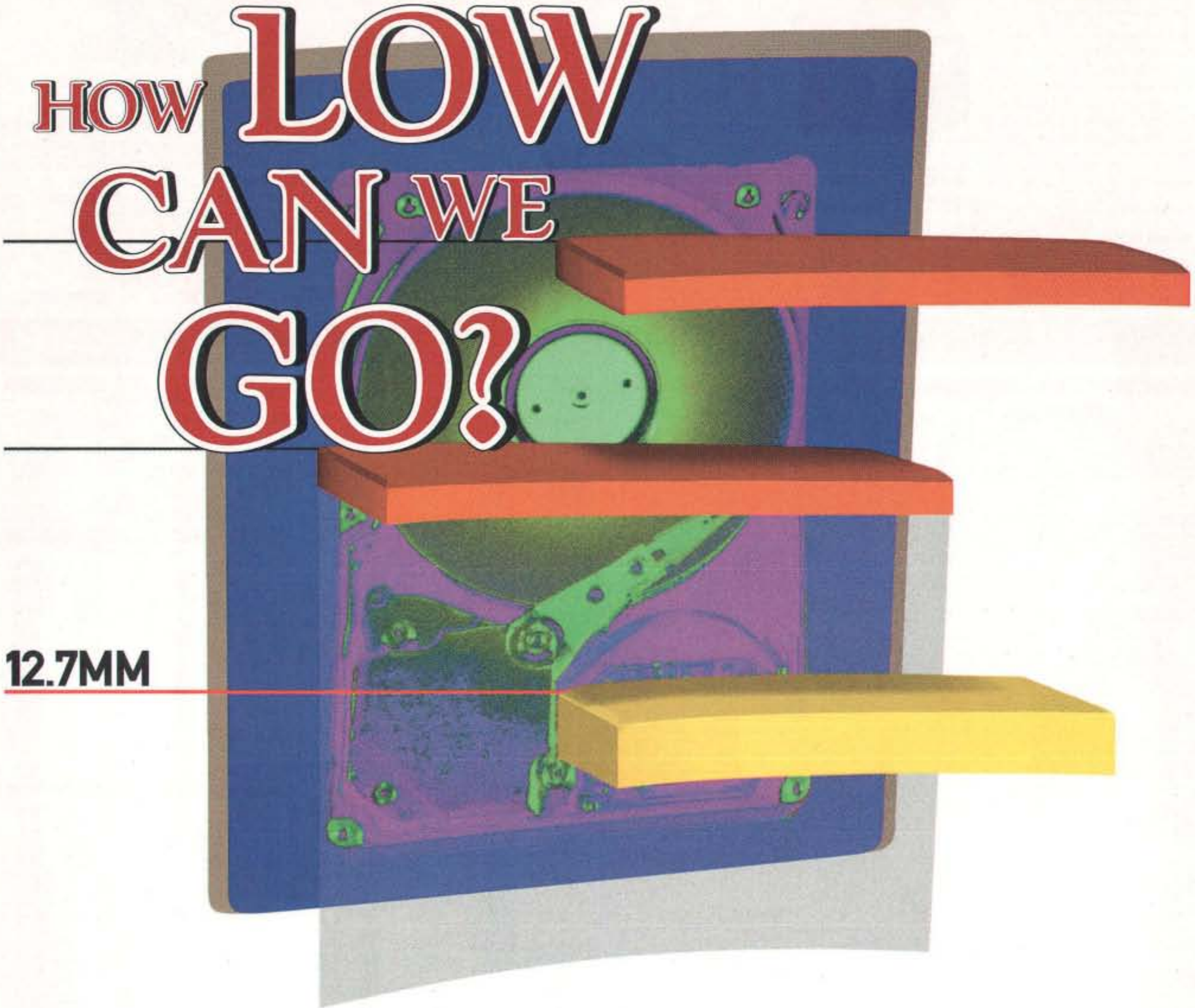

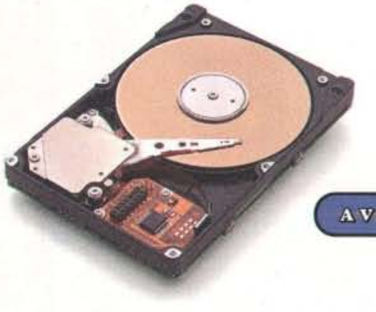

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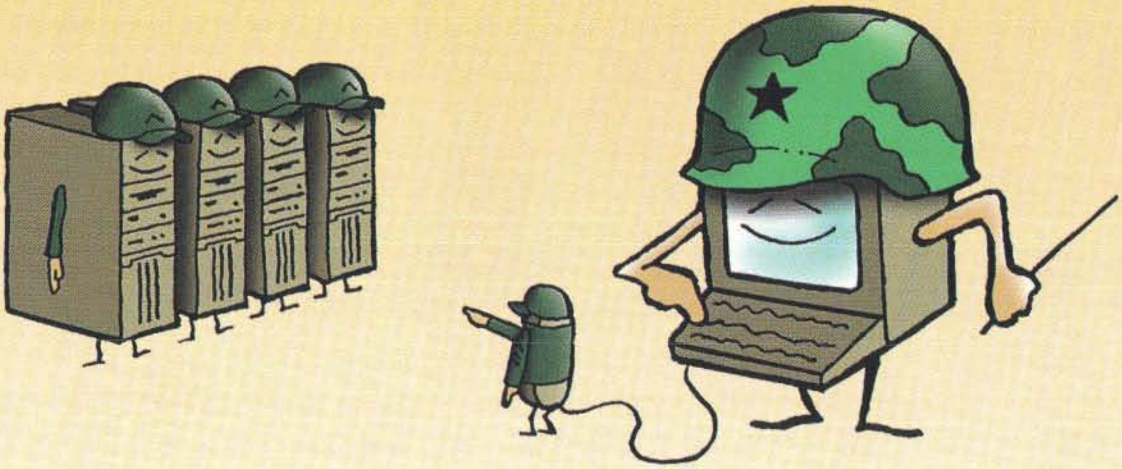

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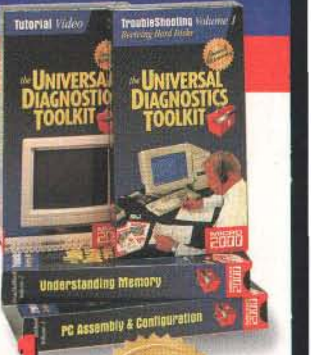
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Simply load the supplied disk into each computer on site (up to 100 PCs recordable on each disk). **CENSUS** automatically records complete system information and assigns each PC a unique ID number. The data can now be downloaded from the disk into any database program so it's ready to retrieve at a moments notice. For even greater productivity and speed, use CENSUS in combination with MICRO-SCOPE CLIENT to remotely diagnose each PC and arrive with the exact parts required, fully compatible. You'll be in and out in a flash with a greater profit margin. Call us for information on increasing productivity.

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A PROVEN WAY TO INCREASE QUALITY CONTROL. Completely accurate and thorough diagnostic routines repeatedly test the system's resources to the fullest extent to find any hidden bugs or problems. Essential for OEMs and Repair Facilities—reduces the number of returned PCs dramatically! Runs with or without a monitor or keyboard. User definable run time. Detailed system log written to disk after testing.

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Presario 425, 433, 633, 650, 660, 800C, 800F, 800S, 833, 850, 866 Prolinea MT 4/33s, MT 4/50, MT 4/66, 4/25s, 4/33, 4/50, 4/66, 4/33s, enhanced 4/100, 4/33s, 4/50, 4/50s, 4/66, Net 1/25s, Net 1/33s					
4MB	141684-001	$69	8MB	141685-001	$129
16MB	149320-001	$229	32MB	149147-001	$469
Presario 510, 520, 524, 526, 528, 720, 724, 744, 774, 860, 920, 924, 954					
4MB	147522-001	$49	8MB	147523-001	$99
16MB	147524-001	$199	32MB	147525-001	$429
1MB Video	171017-001				$49
Presario 972, 974, 978, 982, 992, 5526, 5528, 5536, 9536, 9546, 9548, 9564, Prolinea 4100, 466, 5120MX, 575MX, 590MX, 5100, 5133, 5120, 5100, 575, 590, Prolinea 450, 5100e, 5120e, 575e, 6150e, 6180e, Deskpro 4100, 450, 466, 575MX, 590MX, 5100, 5120, 5133, 575, 590					
4MB	172712-001	$49	8MB	172713-001	$99
16MB	172714-001	$199	32MB	172715-001	$429
1MB Video	171017-001				$49
256K Cache	223557-001				$49
Presario 7212, 7222, 7232, 7234, 7240					
8MB	236548-001, 236512-001				$129
16MB	236548-002, 236513-001				$259
32MB	n/a	$489	64MB	n/a	$799
1MB Video	236709-001				$49
Presario 9232, 9234, 9240, 9250, 9642, 9660					
8MB	234567-001	$99	16MB	234566-001	$229
32MB	n/a	$399	64MB	n/a	$899
1MB Video	213922-001				$49
Prolinea 5133 2000/ML, 5150 2000/ML, 5166 2000/ML, 5100 840/1200, 5120 1200, 5133 1200/2000, 5150 1200/2000, 5166 1200, Deskpro 5133 2000/ML, 5150 2000/ML, 5166 2000/ML, 5100 840/1200, 5120 1200, 5133 1200/2000, 5166 1200/2000, 575 840					
8MB	243011-001	$129	16MB	243012-001	$259
32MB	243013-001	$489	64MB	243014-001	$799
1MB Video	171017-001				$49
2MB Video	223335-001				CALL
6MB Video	223336-001				CALL
Deskpro XE 560, 5/66M, 5/60M					
16MB	149949-001	$259	32MB	149912-001	$499
64MB	149913-001	$799	128MB	149914-001	$1699
1MB Video	139167-001				$49
Deskpro XL 450, 466, 560, 566, 5100, 5120, 5133, 575, 590					
8MB	148188-001	$129	16MB	148189-001	$259
32MB	148190-001	$469	64MB	148191-001	$799
1MB Video	139167-001				$49
Deskpro XL 6150 1050/CDS, 2100/PD, XL 6200 2100/PD					
16MB	210948-001	CALL	32MB	228417-001	CALL
64MB	228418-001				CALL
2MB Video	223335-001				CALL
6MB Video	223336-001				CALL
Deskpro XE 4100, 433s, 450, 466					
4MB	141684-001	$69	8MB	141685-001	$129
1MB Video	139167-001				$49
256K Cache	194358-001, 194358-002				$49
Deskpro 3/25i, 3/33i, 386/25M, 386/33M, 4/25S, 4/33I, 4/66i, 486/33M, 486/50M, 486/66M, 486s/16M, 486s/25M, 486s/33M					
4MB	118690-001	$69	8MB	128877-001	$129
512K Video	141236-001				$39
1MB Video	139167-001				$49

DELL

Power Desktop 486 Models					
4MB	310-2507	$69	16MB	310-2625	$229
PowerEdge XE, OptiPlex, Dimension XPS, OmniPlex ME 486 & Performance M/L/T Models					
4MB	310-3325	$49	8MB	310-6083	$99
16MB	310-3327	$199	32MB	n/a	$399
Performance ME, OmniPlex Pentium ME, OptiPlex DGX, PowerEdge SP/XE/EL Models					
8MB	310-3335	$139	16MB	310-3336	$259
32MB	310-3337	$459	64MB	n/a	$799
Powerline Workstations SE & DE Models					
8MB	310-2468	$129	16MB	310-2469	$259
32MB	310-2630	$459			
Dimension XPS & OptiPlex XL/XM/XMT Pentium Models					
8MB	310-2647	$139	16MB	310-3374	$259
32MB	310-3375	$459	64MB	310-3368	$799
DECpc MTE, LP & MT Models					
4MB	FR-PC74M-AA	$69	16MB	FR-PC74M-AB	$259
Starion & Venturis Models					
4MB	FR-PCVAM-AA	$49	8MB	FR-PCVAM-AB	$99
16MB	FR-PCVAM-AC	$199	32MB	FR-PCVAM-AD	$399

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16MB	n/a	$259	32MB	n/a	$489

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ValuePoint 6384/6472/6482/6484/6492/6494/6381 SI Models					
4MB	92G3131	$69	8MB	92G0130	$129
16MB	92G0160	$229	32MB	92G0320	$469
PS/ValuePoint 6384, PS/1 Consultant/Essential/Expert Models					
4MB	96F9290	$69	16MB	96F9291	$229
PS/ValuePoint 6382/6384/6387, PS/1 Advisor/Consultant/Essential/Expert/Willow/Investor Models					
4MB	6450128	$69	8MB	6450130	$129
16MB	92G7204	$229			
PC 700 Model 750/6887, Model 730/6877					
8MB	92G7318	CALL	16MB	92G7320	CALL
32MB	92G7322	CALL	64MB	92G7324	CALL
PC 700 Model 750/6885/6886, Model 730/6875/6876					
4MB	73G3131	$69	8MB	6450130	$129
16MB	92G7204	$229	32MB	92G7205	$469
PS/2 25/286, 30/286, 35SX/LS, 40SX, 50Z, 55SX/LS, 65SX/LS, 70, 80, 90XP, 95XP					
2MB	30F5360, 6450604, 6450608, 6450379				$69
4MB	34F2933, 87F9977, 6451060				$79
8MB	6450129				$129
Expansion Boards for PS/2 Systems					
4-16MB w/4MB	6450609				$224
2-14MB w/2MB	34F3077				$209
4-16MB w/4MB	34F3011				$209

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PowerMate & Ready 486 Models					
4MB	158-082223-000	$69	16MB	158-082222-000	$129
PowerMate 486 D/M Models					
4MB	OP-410-4003	$49	8MB	OP-410-4004	$99
16MB	OP-410-4005	$199	32MB	OP-410-4006	$399

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Bravo LC & MS Pentium Models					
8MB	503008-001	$129	16MB	503008-002	$259
32MB	503008-003	$519	64MB	503008-004	$979
Manhattan V & G Models Premmia 4/33, 4/33s, 4/50d, 4/66d, MTE 4/33, 4/66d, P/60, SE 4/33, SE 4/66d, SE P/60					
8MB	501159-002	$109	16MB	501159-003	$209
32MB	501159-004	$399	64MB	501159-005	$749
Bravo LP, MT, LC (II) & LC (III), Premmia MX & LX & Advantage! Models					
4MB	500987-002	$49	8MB	500987-003	$99
16MB	500987-004	$199	32MB	500987-005	$399
Bravo 4/33 (original), 4/25, Premium, TE, Premium II, Power Premium Models					
4MB	500780-004	$79	8MB	500780-001	$159

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Netservers & Vectra VL2 Models					
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4MB	D2690A	$49	8MB	D2691A	$99
16MB	n/a	$199	32MB	n/a	$399
Vectra 486 XM/ST/U/T/N/M/NI/MI/VL Models					
4MB	D2156A	$69	8MB	D2152A	$129
16MB	D2676A	$229			

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Aptiva (all models) & PC 300 Model 330/350					
4MB	92G7539	$49	8MB	92G7541	$99
16MB	92G7543	$199	32MB	92G7545	$399
1MB Video	92G7443				$49
256K Cache	92G7231				$79

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Pro Magnum Series & Power Server Series Models					
4MB	n/a	$49	8MB	n/a	$99
16MB	n/a	$199	32MB	n/a	$399
PCI Mellennia Series, Power Station Series & Home MPC Series Models					
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16MB	n/a	$259	32MB	n/a	$489

Packard Bell™

Executive Series, Force Series & Legend Series Models					
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16MB	n/a	$199	32MB	n/a	$399

LASER PRINTER MEMORY

HP LaserJet 4L					
1MB	C2024A				$48
HP LaserJet 5L					
1MB	C3939A	$50	2MB	C3147A	$79
4MB	C3148A	$99	8MB	n/a	$239
HP LaserJet IIP, III, IIIP, IIID					
2MB	33475B	$79	4MB	33477B	$129
HP LaserJet II, IID					
2MB	33444B	$79	4MB	33445B	$129
HP LaserJet IIIsi, 4, 4M, 4Si, 4SiMX, XL300, DeskJet 1200c					
1MB	C2063A	$48	2MB	C2064A	$89
4MB	C2065A	$99	8MB	C2066A	$199
HP LaserJet 4P, 4MP, Color LaserJet					
2MB	C3131A	$50	4MB	C3132A	$55
HP DeskJet 500, 500C, 520, 520C, 550C, 560, 560C					
256K	22707B				$40
HP DesignJet 5P, 5MP					
4MB	C3132A	$55	8MB	C3133A	$209
HP LaserJet 5, 5N, 5M, 5Si, 5SiMX, 5+5M Color					
2MB	C3131A	$50	4MB	C3132A	$55
8MB	C3133A	$99	16MB	n/a	$209
Okidata OL400					
1MB	70014701				$79
2MB	n/a				$129
Okidata OL400E					
2MB	n/a				$119
4MB	n/a				$189

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Ascentia 800N & 810N Models					
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16MB	501488-003				$399
Ascentia 900N & 910N Models					
4MB	501392-001	$99	8MB	501392-002	$189
16MB	501392-003				$409
Ascentia 950N Models					
8MB	501728-002	$199	16MB	501728-003	$399
Ascentia J Models					
8MB	501984-001	$199	16MB	501985-001	$399
32MB	501986-001				$799
Ascentia P Models					
8MB	501013-001	CALL	16MB	501013-002	CALL
32MB	501013-003				CALL

COMPAQ

Contura Aero Models					
4MB	190532-001	$99	8MB	190597-001	$199
16MB	190598-001				$459
Contura 4/25, 4/25CX, 4/25c Models					
4MB	146520-001	$125	8MB	146521-001	$209
16MB	1146531-001				$459
Contura 400, 410, 420, 430 Models					
4MB	147653-001	$109	8MB	147655-001	$219
16MB	147657-001				$449
Concerto 4/25, 4/33 Models					
4MB	144790-001	$155	8MB	144790-002	$219
16MB	144790-003				$459
LTE Elite 486 Models					
4MB	199013-001	$125	8MB	199015-001	$219
16MB	199017-001				$449
Elite Pentium 5000 Models					
8MB	213515-001	$209	16MB	213515-002	$439
32MB	213515-003	$829	64MB	213515-004	$1489

Apple Computer

PowerBook 520 & 540 Models					
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PowerBook 5300 Models					
8MB	M3750LL/A	$149	16MB	n/a	$259
24MB	n/a	$359	32MB	n/a	$479

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Latitude 433 Models					
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Latitude 433m/mc, 450mc/mcx, 475mc, LX 4100/475 Models					
4MB	310-3416	$139	8MB	n/a	$289
16MB	310-3417				$449
Latitude XP 450/475/4100, XPi Pentium Models					
4MB	310-3421	$89	8MB	310-3435	$129
16MB	310-3422				$329

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HiNote 486 Models					
4MB	FR-PCP7M-AA	$89	8MB	FR-PCP7M-AB	$179
16MB	FR-PCP7M-AC				$399
HiNote Ultra 486 & Ultra II Pentium Models					
4MB	FR-PCP8M-AA	$89	8MB	FR-PCP8M-AB	$179
16MB	FR-PCP8M-AC				$399
HiNote VP Pentium Models					
8MB	FR-PCP9M-AA	$209	16MB	FR-PCP9M-AB	$479

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WinBook XP, XPC Models					
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- ✓ Most cost effective upgrade path for your system
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TEXAS INSTRUMENTS

TravelMate 4000M Models					
4MB	9793357				$169
Extensa 450 & 455 Models					
4MB	9803932-0001	$89	8MB	9803933-0001	$209
16MB	9804002-0001				$399
Extensa 510 & 515 Models					
4MB	9805763-0001	CALL	8MB	9805763-0002	CALL
16MB	9805763-0003				CALL
Extensa 550, 555, 560, 570 Models					
4MB	9809810-0001	$209	8MB	9804841-0001	$389
16MB	9809811-0001				$699
TravelMate 5000, 5010, 5020, 5100, 5130, 5200, 5270, 5300 Models					
8MB	9798816-0001	$259	16MB	9798816-0002	$489

IBM

ThinkPad 350 Models					
4MB	79F1000	$99	8MB	07G1828	$259
16MB	60G3379				$449
ThinkPad 345, 360C/CE/CSE/P/PE, 370, 755 Pentium Models					
4MB	84G5689	$89	8MB	84G8692	$219
16MB	84G5695	$419	32MB	n/a	$999
ThinkPad 365 C/CS/CD/CSD & 365 E/ED Models					
4MB	92G7287	$99	16MB	92G7293	$359
ThinkPad 365 X/XD & 560 Models					
8MB	92G7340	$239	16MB	92G7341	$519
ThinkPad 500 & 510 Models					
4MB	8189098	$139	8MB	8189099	$199
16MB	8189113				$549
ThinkPad 701 Models					
4MB	92G7259	$109	8MB	92G7261	$199
16MB	92G7263				$349
ThinkPad 750, 755 486 Models					
4MB	07G1420				$109
8MB	07G1421				$179
16MB	66G5109				$389
ThinkPad 760C/CD/L/LD Pentium Models					
8MB	92G7315				$249
16MB	92G7316				$419
ThinkPad 760E/ED/EL/ELD Pentium Models					
8MB	92G7340				$239
16MB	92G7341				$519

TOSHIBA

T1900, T1910, T1950, T1960, T4500, T4600, T4700, T4800,T4850, T4900					
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16MB	PC-PA2014U				$339
T4400 Models					
4MB	PC-PA2004U	$89	8MB	PC-PA2005U	$179
16MB	PC-PA2010U				$399
T2100, T2105, T2110, T2115, T2150, T2155 Models					
4MB	NW2026U	$89	8MB	NW2027U	$179
16MB	NW2028U				$339
T100, T105, T400, T405, T410, T415, T610, Tecra 710/720 Models					
8MB	NW2031U	$199	16MB	NW2032U	$329
32MB	NW2034U				$559
Tecra 700 Models					
8MB	NW2035U	$259	16MB	NW2036U	$499
32MB	NW2037U				$989

NEC

Versa S, 500, 550, 2000, 2200, 2205 Models					
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16MB	OP-410-1203				$329
Versa V, M, P, 4000, 4050, 4080 Models					
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16MB	OP-410-4003	$309	32MB	OP-410-4004	$509
Versa 6000 Models					
8MB	OP-410-62001	CALL	16MB	OP-410-62002	CALL
32MB	OP-410-62003				CALL

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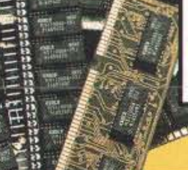

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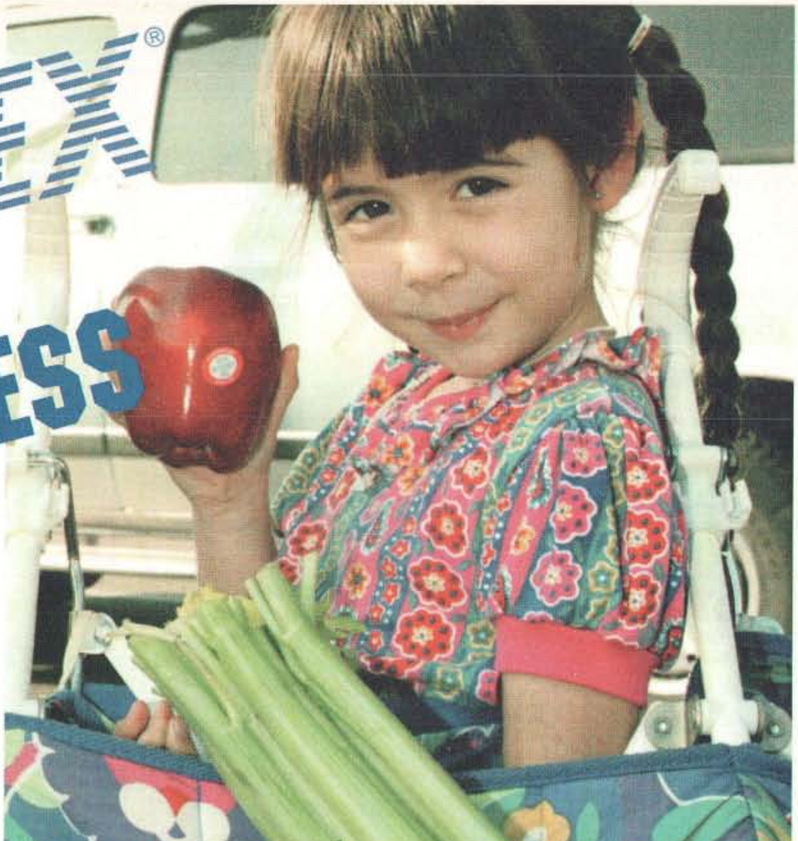
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>
> *Andrew J. Morikawa*
> *President, World SHARE*

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Poland	(42) 30 76 43	(42) 30 76 46
Scotland	0141-554-1185	0141-554-6183
Spain	(1) 372-95-17	(1) 372-81-56
Sweden	(0) 300-511.10	(0) 300-709.10
Thailand	662 370 1313	662 370 1307
Trinidad	(809) 628-9330	(809) 628-9259
Wales	(01222) 763-773	(01222) 763-774

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73-66___-50	50 ft	14.80	13.45	12.33

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I=Ivory W=White

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Part #	Desc.	1-4	5-9
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PP848-5	8 Wire, 48 Port	199	194

Cat 5 - 110 Type RJ45 Jack INSERTS

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KJ-110WH	(White)	$5.50	$5.00

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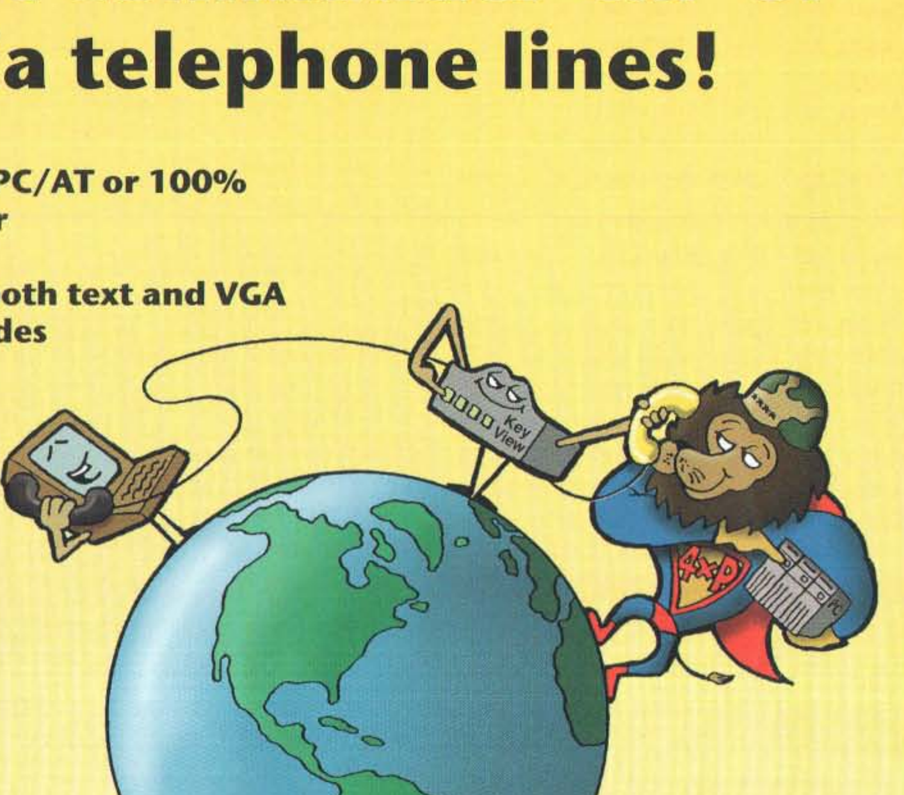

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ST31640A	1.6GB	10.5MS	IDE	275-425
ST32140A	2.2GB	10MS	IDE	295-445
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ST31051N	1.05GB	9MS	SCSI-2	349-474
ST32430N	2.1GB	9MS	SCSI-2	575-700
ST32151N	2.1GB	9MS	SCSI-2	595-720
ST43400N	3.0GB	11MS	SCSI-2	545-695
ST15230N	4.2GB	9MS	SCSI-2	899-1049
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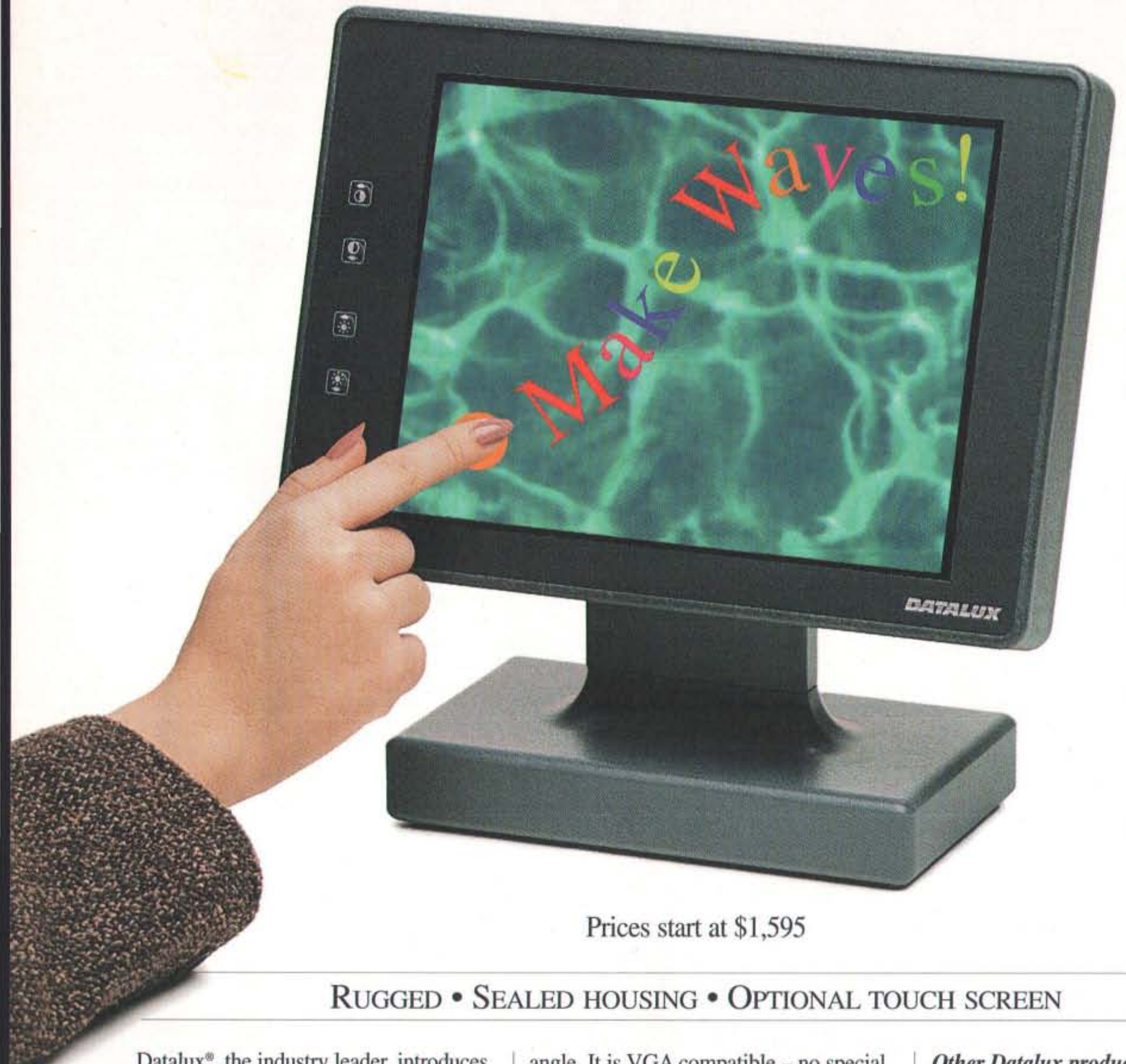

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IBM 6450603, 1Meg ....10^{00}
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CACHE MEMORY

	12NS	15NS	20NS	25NS
8Kx8	–	6.50	6.00	5.50
32Kx8	9.00	4.50	4.25	4.00
32Kx8 (3.3V)	–	14.00	9.50	–
64Kx1	–	11.00	9.00	8.00
64Kx4	–	11.00	9.00	8.00
64Kx8	–	15.00 (5V)	19.00 (3.3V)	–
16Kx4	–	8.00	7.00	6.00
128Kx8	–	29.50	26.00	24.00
32x8 SOJ	–	12.00	11.00	9.00

Call for SOJ Version

CACHE MODULES

256K (160 pin) Pipeline Burst Cache Module $22.00

512K (160 pin) Pipeline Burst Cache Module $39.00

256K (160 pin) Async Cache Module compatible with IBM Aptiva $59.00

Individual D-RAM Chips

MEMORY FOR IBM & APPLE

	50NS	60NS	70NS	80NS	100NS
1Megx1	–	6.85	6.45	5.95	4.95
1Megx4	–	49.00	39.00	38.00	–
1Megx4 (Zip Pk)	–	24.00	22.00	21.00	–
256x4(Page Dip)	–	7.25	6.75	6.50	5.95
256 4(Static Dip)	–	–	9.95	–	–
256x4(Page Zip)	–	9.25	9.00	8.95	–
256x4(Video Zip)	–	–	10.95	9.95	7.95
256x8(SOJ)	–	19.00	18.00	–	–
256 x1	–	3.25	2.95	2.75	2.25
64x4	–	–	–	3.75	–
64x1	–	–	–	–	2.00
256x16 SOJ	–	39.00	29.00	–	–
256x16 SOJ Edo	–	39.00	–	–	–
256x16 Video Zip	–	49.00	39.00	–	–

INTEL Math Chips

80287-XL	49.00
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	40NS	50NS	60NS	70NS	80NS	100NS
256 x 9	–	–	–	6.00	5.00	5.00
1Meg x 9 (3 chip)	–	–	17.00	13.00	13.00	–
1Meg x 9 (9 chip)	–	–	24.00	22.00	21.00	17.00
4Meg x 9	–	–	65.00	60.00	59.00	–
16Meg x 9 (9 chip)	–	–	249.00	239.00	239.00	–

72 PIN SIMMS (FPM, EDO)

	60NS	70NS	80NS
256 x 36 1 mg	22.00	19.00	19.00
512 x 36 2 mg	34.00	29.00	29.00
1 meg x 36 4 mg	55.00	52.00	49.00
2 x 36 8 mg	99.00	94.00	94.00
4 x 36 16 mg	164.00	159.00	159.00
8 x 36 32 mg	329.00	319.00	319.00
16 x 36 64 mg	869.00	859.00	859.00
1 x 32 4 mg	39.00	36.00	36.00
2 x 32 8 mg	74.00	69.00	69.00
4 x 32 16 mg	139.00	134.00	134.00
8 x 32 32 mg	269.00	259.00	259.00
16 x 32 64 mg	809.00	799.00	799.00
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2 x 32 8 mg EDO	74.00	69.00	69.00
4 x 32 16 mg EDO	149.00	139.00	139.00
8 x 32 32 mg EDO	299.00	270.00	270.00

DIMMS (168 pin)

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8 x 64	64Meg	679.00
16x64	128Meg	Call
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3.3V SDRAM	16Meg	349.00
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144 Pin, 5V EDO	8Meg	159.00
144 Pin, 5V EDO	16Meg	309.00
144 Pin, 5V EDO	32 Meg	599.00
144 Pin, 5V EDO	64Meg	3039.00

AST MEMORY

MODEL	AMT. UPGRADED	AST PART #	PRICE
Bravo LC Series, Bravo MT, Bravo MS, MS-L, Advantage Pro DX33, SX25	4Meg	500987-002	39.00
	8Meg	500987-003	78.00
	16Meg	500987-004	139.00
	32Meg	500987-005	278.00
Premmia LX P/60, MX4/66d, 4/100T, P/60	8 Meg	500987-003	78.00
	16 Meg	501340-002	180.00
	32 Meg	500987-005	278.00
	64 Meg	501569-001	649.00
Premmia 4133, 4133S, 4/50d, 4/60d	8 Meg	501159-002	89.00
Premmia SE 4/33, 4/66d, P/60	16 Meg	501159-003	149.00
Premmia MTE 4/33, 4/66d, P/60	32 Meg	501159-004	329.00
Manhattan G, V Series Server	64 Meg	501159-005	859.00
Power Premium 3/33, 4/33, 4/33S, 4/50d, 4/66d	8Meg	500780-001	168.00
Premium 486/25, 486/25E, 486/33, 486/33E			
Premium 386/33TE, 486/25TE, 486/33TE			
Prem. II 386/25, 386/33, 486/33, 486 SX/20			
Bravo 486/25, 486/33	2 Meg Kit	500780-005	88.00
Advantage 486/25, 486/33, 486/33P, 486 SX/20			
Premium SE4/22	8Meg Kit	500780-001	168.00
Premium SE 4/50, d, 66d, P/60	1 Meg	500780-003	19.00
Prem. 386/33T, 386 SX16, Prem.II 386SX 20, 386/25	4Meg	500780-004	84.00
Premmia GX P/90, P/100	8Meg Kit/16MegKit	501565-001/501566-001	98/178
	32Meg Kit/64Meg Kit	501567-001/501568-001	319/869
AST Cupid Board	0-32 Meg	500818-001	159.00

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Ambra NC 425SL	2/4/8 Meg	69/109/189
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6450604/92G7196 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	39.00
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 325T	29.00
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	69.00
87F9977/92G7199 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	69.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	69.00
92F9694 (4Meg)	P/S1 & P/S1/386SX, Model-2121	69.00
92G7200 (4Meg)	PSI Expert, Consultant, Willow	69.00
4Meg/8Meg/16Meg/32Meg	***PC 300 Series***	***39/69/144/309***
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92G7539 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730, Pentium	39.00
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6450128/92G7200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt 77, 486CS2, 486SX, SVR85 Value Point 77 486DX2, 486SX, SVR 85	49.00
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66G0094 (4Meg)	Thinkpad 755, 360, 355, 340, 450	49.00
66G0094 (8Meg)	Thinkpad 755, 360, 355, 340, 450	149.00
66G0094 (16Meg, 32Meg)	***Thinkpad 755, 360, 355, 340, 450***	***229/599***
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8189098 (4Meg)	Thinkpad 500, 510CS (3.3 volt)	89.00
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79F0999 (2Meg)	LX40, N33SX, PS Note	69.00
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c, PS Note 425	99.00
79F1001 (8Meg)	LX40, N33SX, PS Note	159.00
Hard Drive (810 Meg, 1.3 Gig)	Thinkpad 750, 755, 360, 355	479/819
(4Meg/16Meg)	Thinkpad 755 Dimm Modules	95/219
(4Meg/16 Meg w/Adap	Thinkpad 755	174/389
60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	139.00
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	249.00
4Meg/8Meg/16Meg	***Thinkpad 365***	***119/219/429***
92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	79.00
92G7261 (8Meg)	Thinkpad 701C, CS, Butterfly	149.00
92G7263 (16Meg, 32Meg)	Thinkpad 701C, CS, Butterfly	299/Call
8Meg/16Meg	Thinkpad 820	219/399
4Meg/8Meg/16Meg/32Meg	Thinkpad 850	99/169/299/499
8Meg/16Meg/32Meg	***Thinkpad 760***	***169/279/559***
Hard Drive (810Meg)	***Thinkpad 760***	***479.00***

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Deskpro 386/25, 20	1Meg Module/4Meg Module	79/129
Deskpro System Pro 386/33, 486/25, 486/50L	2/8/32Meg	89/199/449
Deskpro 4/66I, 4/33I, 4/25IS, 3733L, 3/25I	2/4/8Meg	59/89/169
Deskpro "M" Series	Expansion Board 0K	119
Deskpro 450, 466, 4100, 575, 590, 5120, 5133	4/8/16/32Meg	49/99/179/339
Deskpro XE 433S, 450, 466	2/4/8Meg	49/99/179
Deskpro XE 560 (pairs)	4/8/16/32/64Meg	39/69/139/299/799
Deskpro XL450, 466, XL560, xl566, XL575, 5100 xl590	4/8/16/32/64Meg	39/69/139/299/799
Presario 433, CDS520, CDJV520, CDL524, CDS526, CDTV528 660, CDS660, CDS720, CDS724, CDS744, CDS860 CDS920, CDTV920, 924, CDS924, CDS954	4/8/16/32Meg	39/69/139/299
Presario 400 Series, 600 Series, 800 Series	4/8/16/32Meg	39/69/139/299
Presario CDS774, CDS972, CDS982, CDTV978, CDS974 (in pairs) CDS992, 7152, 7170, 7180, 9546, 9548, 9564	4/8/16/32Meg	39/69/139/299
Prolinea 4/25S, 4/33, 4/33S, 4/50, 4/66, CDS	1/2/4/8Meg	19/29/49/99
Prolinea MT 4/33S, 4/50, 4/66, Enhanced 4/33S, 4/50S, 4/50, 4/66	4/8/16/32 Meg	39/69/139/299
Prolinea 450, 466, 4100, 575, 590, 5120, 575, 590, 5120 575 mini, 5100 mini, 5133 mini	4/8/16/32Meg	39/69/139/299
Proliant 1500 5/75, 5/100, 1500R 5/75, 5100 (install in pairs)	4/8/16/32Meg	39/69/139/299
Prosignia 300, 575, 590, 500 5/90, 500 5/120 (install in pairs)	4/8/16/32Meg	39/69/139/299
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LTE/386S/20	4Meg Module	121125-002	95.00
LTE LITE/20, 25, 25C	4Meg Module	129769-002	95.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	149.00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	279.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	89.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	169.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	279.00
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	16Meg	144790-003	289.00
Contura 320, 325	4Meg	139498-001	99.00
	8Meg	139499-001	159.00
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Contura 4/25, 4/25C, 4/25CX	4Meg	146520-001	89.00
	8Meg	146521-001	149.00
	16Meg	146531-001	269.00
Aero 4/25, 4/33	4Meg	190532-001	79.00
	8Meg	190597-001	149.00

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S-RAM Cards 2MEG	199	Portable CD ROM (4x & 6x)	Call
28.8/14.4 Data/Fax Modem	189	***SCSI Type II***	***139***
14,400/14,400 Data/Fax Modem	94	***Audio Card***	***149***
Readwriter Card (ISA Slot)	149	Multimedia Combo, Sound/SCSI	499
Lan Ethernet (Coax), (10 Base T)	89	Type III 340 Mg Hard Drive	479
		Xircom Combo Ethernet + Modem II 28.8 Adapter	549

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TOSHIBA LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
Tecra 700, 710, 720 (SDRAM)	***8Meg/16Meg/32Meg***		***245/459/889***
Tecra 700, 710, 720	***810Meg/1.3Gig***		***729/819***
T2000SXE/2200SX/T1800, 1850, C	2Meg/4Meg/8Meg	PC-PA2000U	69/99/179
T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		89/139/279/319
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	89.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	149.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	279.00
T4700, 4800, 4850 (Hard Drive)	810Meg/1.3 Gig		729/809
T3400CT, T2400, T3600	4Meg/8Meg/16Meg	PC-PA2019U	99/139/279
T600, 610, CT Edo	8Meg/16Meg/32Meg		129/279/559
T400CS, 400CDT, T100, 105 Edo	***8Meg/16Meg/32Meg***		***129/279/559***

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
ACER 730, 735C, 760, 780	2Meg/4Meg/8Meg		49/79/139
ACER 763, 765, 782, 784, 786, 787,	4Meg/8Meg/16Meg		79/129/299
ACER 750	4Meg/8Meg/16Meg		79/129/299
ACER Note Pro, ACER Note Lite	***4Meg/8Meg/16Meg***		***69/125/265***
ARM T538	4Meg/8Meg/16Meg		89/169/299
AST Ascentia J10	***8Meg/16Meg/32Meg/40Meg Kit***		***119/219/439/Call***
AST Ascentia 900N, 800N, 810, 910	4Meg/8Meg/16Meg		89/179/299
AST Ascentia 950	8Meg/16Meg		149/299
AST Bravo & Explorer	***4Meg/16Meg***	***501255-001, -002***	***79/329***
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	69.00
AST Power Exec 3/25C, 425EL, 425SL	4Meg/16Meg	501166-001, -003	89/299
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	89/299
AT&T Globalyst 130, 200 *(Call for other Globalyst)*	4Meg/8Meg/16Meg		89/139/279
AT&T Safari NSX/20	4Meg	PEC 37651	149.00
Austin DX4, DX2, SX2, SX Series	4Meg/16Meg		89/299
Austin Vista	***4Meg/8Meg/16Meg/20Meg***		***Call***
Canon Innova Book 150	4Meg/16Meg		89/229
Canon Innova Book 200LS	4Meg/8Meg/16Meg/24Meg		89/159/299/499
Canon Innova Book 350CD, 360, 475	***4Meg/8Meg/16Meg***		***89/119/219***
Canon Innova 486-10	4Meg/16Meg		89/299
Canon Notejet 486-25	4Meg/8Meg		89/229
Canon Notejet 486-33, 486C, 25 and 33	4Meg/8Meg		89/229
Canon Notejet 486c, 75, 100	8Meg/16Meg		169/379
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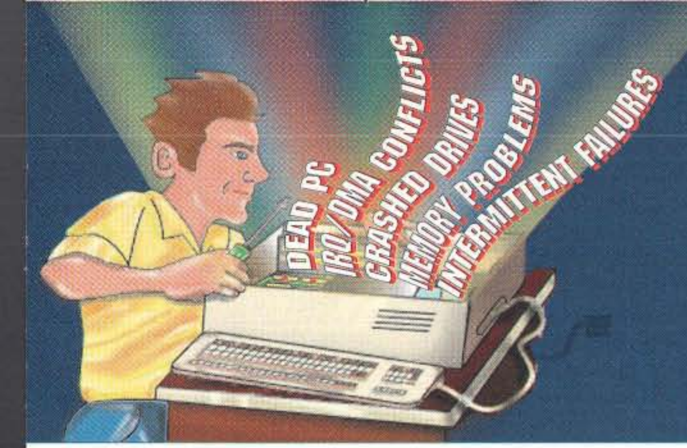

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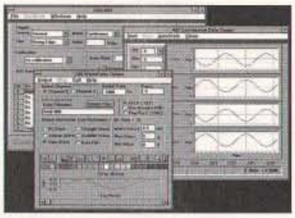

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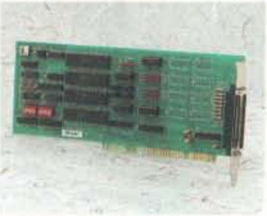

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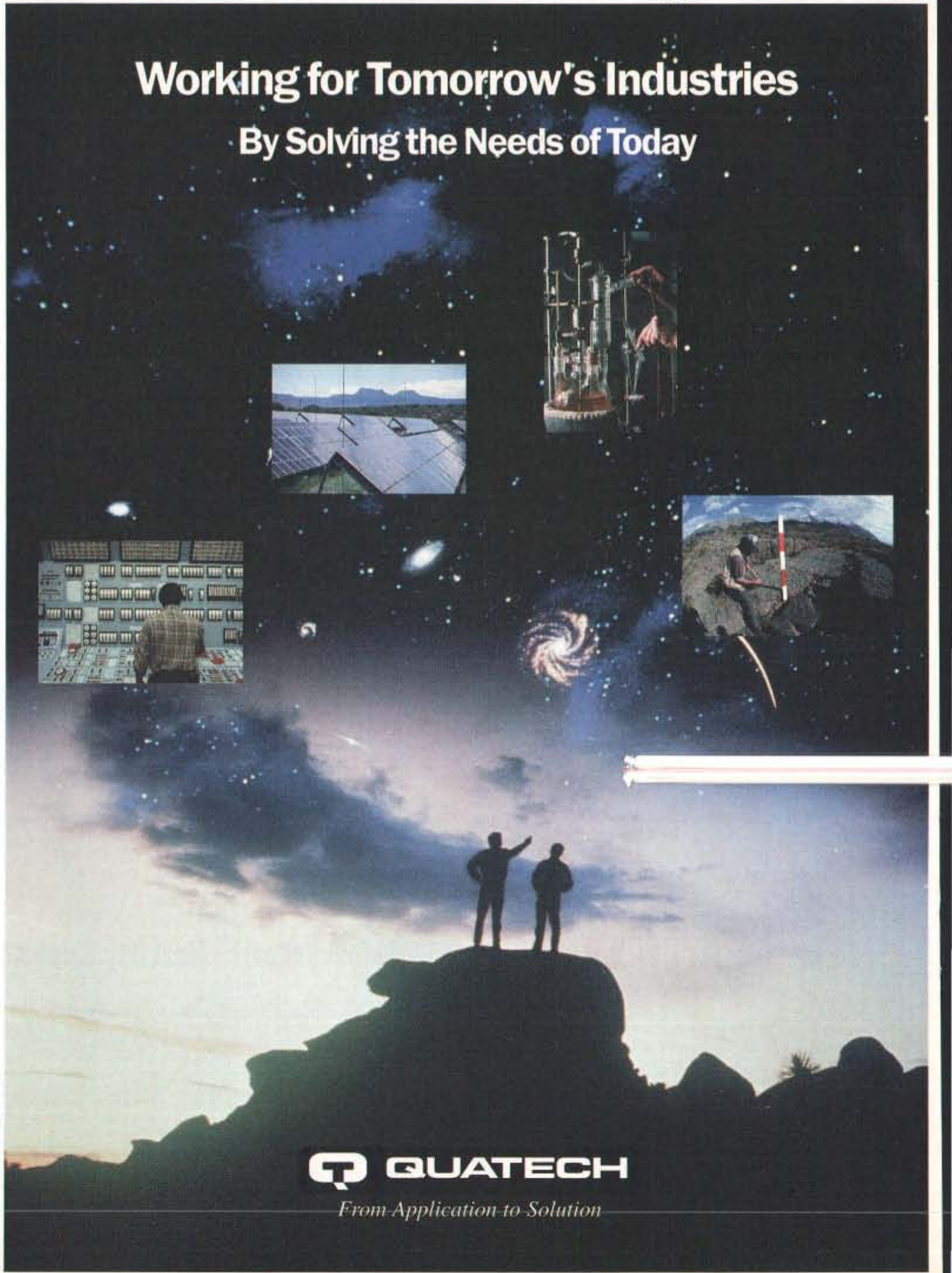
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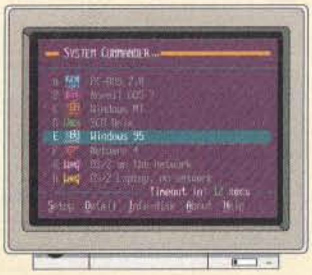

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• SCSI DRIVES •

Brand	Model	Spin	Speed	Internal	External
NEC	CDR222	4X	200ms	$99	$189
Sony	CDU76S	4X	250ms	$125	$215
Pioneer	DRU124X	4.4X	140ms	$109	$199
Plextor	PX43CE	4.5X	130ms	$239	$329
Teac	CD56S	6X	160ms	$235	$325
NEC	CDR512	6X	150ms	$249	$339
Plextor	PX63CS	6X	145ms	$279	$369
Philips	PC80S	8X	195ms	$239	$319
NEC	CDR1410	8X	145ms	$259	$349
Toshiba	XM5601B	8X	145ms	$269	$359
Plextor	PX83CS	8X	115ms	$415	$505

Mac kits also available.

• ATAPI DRIVES (IDE) •

Brand	Model	Spin	Speed	Internal	Int Kit
Mitsumi	CRMCFX400	4X	230ms	$65	$80
Toshiba	XM5302B	4X	190ms	$71	$86
Toshiba	XM5522B	6X	170ms	$89	$104
NEC	CDR1300	6X	145ms	$99	$114
Teac	CD56E	6X	110ms	$119	$134
Teac	CD58E	8X	110ms	$129	$144
Toshiba	XM5602B	8X	145ms	$145	$160
New	IDECD10X	10X	130ms	$289	$304

Sound Blaster 16 PnP $99 Sound Blaster 32Pnp $155

• CD CHANGERS •

CD ROM Changers allow you to have multiple disks online at one time. No more switching disks.

Brand	Model	Disks	Spin	Speed	Price
Internal IDE					
New	CDR3X4	3	4X	230ms	$99
NEC	CDR4X4	4	4X	250ms	$179
External SCSI					
Pioneer	DRM-624X	6	4.4X	190ms	$299
Pioneer	DRM-1804X	18	4X	300ms	$1899

• CD ROM TOWERS •

For fast access to multiple CD's at one time. Perfect for schools, BBS, networks, and more. Toll free support.

			4 Drives	7 Drives
4X	200ms	NEC	$759	$1259
4.4X	140ms	Pioneer	$799	$1299
4.5X	130ms	Plextor	$1499	$2529
6X	160ms	Teac	$1439	$2439
6X	150ms	NEC	$1559	$2629
6X	145ms	Plextor	$1699	$2899
8X	195ms	Philips	$1459	$2499
8X	145ms	NEC	$1559	$2629
8X	145ms	Toshiba	$1999	$3449
8X	115ms	Plextor	$2299	$3999

2 to 21 drive configurations available. Call.

PARALLEL DRIVES

High quality! Plugs into any parallel printer port. Output for concurrent printer use. EPP compliant for high performance.

Hard Drives (3yr warranty on drive mechanism)

1Gig [SSSPP1GIG]	$349	2Gig [SSSPP2GIG]	$479
1.6Gig[SSSPP1.6GIG]	$429	2.5Gig [SSSPP2.5GIG]	$525

CD ROM Drives

4X [SSSPP4XCD]	$179	8X [SSSPP8XCD]	$299
6X [SSSPP6XCD]	$229	10X [SSSPP10XCD]	$489

HOT PRODUCTS

Plug-N-Play Hard Card

Out of drive bays? Looking for an easy way to upgrade your hard drive storage capacity? This hard disk card from *Smart Storage Solutions* is the answer. Just insert the card in a 16 bit slot. It comes preformatted and will work in any 386 or higher computer.

1Gig [SSS1GIG]	**$299**	**2Gig** [SSS2GIG]	**$439**
1.6Gig [SSS1.6GIG]	**$399**	**2.5Gig** [SSS2.5GIG]	**$499**

Fixed Disk Performance
With all the Removability Advantages

MCD

3 1/2" x 1" drive, 10ms 2 year drive warranty, 5 year cartridge warranty. Compatible with SyQuest 270 media.

Internal SCSI with 1 cartridge	$389
External SCSI with 1 cartridge	$449
Parallel Ext with 1 cartridge	$519

Ultimate Speakers!

Get fantastic sound quality for your computer from these high quality speakers. These component style speakers include separate sub-woofer and professional quality swivel satelite speakers, similar to high end home speakers. Pro model (pictured) features wall rattling base and crisp, clean highs. Jr model features same great satellite speakers with a smaller sub-woofer.

Sound Image Jr 25 Watts	[SPEAKERJR]	$99
Sound Image Pro 35 Watts	[SPEAKERPRO]	$129

SCSI HARD DRIVES

SCSI	Speed	RPM	Brand	Model	Price
1050MB	9ms	5400	Seagate	ST31055N	$339
1080MB	11ms	5400	Seagate	ST51080N	$249
1280MB	12ms	5400	Quantum	FB1280S	$276
2050MB	8.5ms	7200	Micropolis	MC4221	$544
2050MB	8.5ms	7200	Micropolis	MC4221AV	$600
2147MB	9ms	5400	Micropolis	MC4421	$444
2147MB	9ms	5400	Seagate	ST32155N	$559
2147MB	8ms	7200	Seagate	ST32550N	$675
2150MB	8ms	7200	Quantum	XP32150	$630
4290MB	8ms	7200	Seagate	ST15150N	$989
4290MB	9ms	5400	Seagate	ST15230N	$905
4294MB	8.9ms	7200	Micropolis	MC3243	$859
4294MB	8.9ms	7200	Micropolis	MC3243AV	$945
4300MB	8.6ms	7200	Quantum	XP34300	$900
9091MB	12ms	5400	Micropolis	MC1991	$1840
9091MB	12ms	5400	Micropolis	MC1991AV	$1959
9080MB	11ms	5400	Seagate	ST410800N	$1880
WIDE SCSI					
1050MB	8.5ms	7200	Quantum	XP31070W	$509
2050MB	8.9ms	7200	Micropolis	MC4221W	$630
2050MB	8.9ms	7200	Micropolis	MC4221WAV	$689
2147MB	8ms	7200	Seagate	ST32550W	$675
2150MB	8ms	7200	Quantum	XP32150W	$680
4294MB	8.9ms	7200	Micropolis	MC3243W	$945
4294MB	8.5ms	7200	Micropolis	MC3243WAV	$1035
4294MB	8ms	7200	Seagate	ST15150W	$1065
4300MB	8.6ms	7200	Quantum	XP34300W	$959
9080MB	11ms	5400	Seagate	ST410800W	$2029
9100MB	12ms	5400	Micropolis	MC1991W	$1929
9100MB	12ms	5400	Micropolis	MC1991WAV	$2049

TAPE DRIVE SALE

Capacity	Brand & Model	Price
	• SCSI •	
2-4GB	Seagate TSM4000	$309
4-8GB	Seagate TST8000	$399
	• 4mm DAT DRIVES •	
2GB	Hewlett Packard C1534	$609
2GB	Seagate C4320RT	$599
2-4GB	Seagate C4324RP	$679
2-4GB	Hewlett Packard C1536	$699
4-8GB	Seagate C4326NP (DDS2)	$859
4-8GB	Hewlett Packard C1533A	$879
24-48GB	HP External 6 tape loader C1553AX	$2379
	• 8mm DAT DRIVES •	
3.5-7GB	Exabyte EXB8205XL	$1269
7-14GB	Exabyte EXB8700LT	$1149

• QIC •

800MB	**$141**
1GB	**$159**
1.7GB	**$219**
3.2GB	**$249**
4.4GB	**$259**

Seagate

Save $10 on these Seagate tape backups with any hard drive purchase.

REMOVABLE DRIVE BRACKET

Converts any 3 1/2" hard drive into a removable drive. Great for transportability, data interchange, or security needs. Extremely high quality construction. Metal cartridge and frame, cooling fan, SCSI unit has ID select on the cartridge. Qty discounts available.

	System	Extra Cartridge	Extra Frame
IDE	**$79**	**$39**	**$49**
SCSI	**$85**	**$40**	**$54**
WIDE SCSI	**$129**	**$64**	**$75**

IDE HARD DRIVES

IDE	Speed	RPM	Brand	Model	Price
631MB	14ms	3800	Seagate	ST3630A	$170
639MB	11ms	4500	Western Digital	AC2635	$170
850MB	10ms	4500	Western Digital	AC2850	$179
850MB	14ms	4500	Quantum	TB850A	$179
1080MB	11ms	5400	Seagate	ST51080A	$190
1084MB	14ms	4480	Maxtor	M71084A	$195
1090MB	11ms	4500	Fujitsu	M1614T	$175
1250MB	15ms	3600	Quantum	BF1250A	$189
1280MB	12ms	5400	Quantum	FB1280A	$216
1280MB	10ms	5200	Western Digital	AC21200A	$205
1282MB	10.5ms	5400	Seagate	ST51270A	$195
1330MB	12ms	4480	Maxtor	M71336A	$205
1624MB	10ms	5200	Western Digital	AC31600	$235
1625MB	10.5ms	5400	Seagate	ST31640A	$249
1626MB	12ms	4480	Maxtor	M71626AP	$235
1700MB	11ms	4500	Quantum	SR31700A	$236
2004MB	12ms	4480	Maxtor	M72004A	$279
2100MB	10ms	5200	Western Digital	AC32100	$299
2167MB	10ms	5400	Seagate	ST32140A	$285
2168MB	10.5ms	4500	Quantum	TM32160A	$289
2500MB	15ms	3600	Quantum	BF2500A	$295
2500MB	11ms	4500	Quantum	SR32550A	$335
2559MB	11ms	5200	Western Digital	AC32600	$350
3254MB	10.5ms	4500	Quantum	TM33200A	$369

REMOVABLES

OPTICAL DRIVES

230MB	Fujitsu IDE Bare	$369
230MB	Fujitsu SCSI Bare	$419
640MB	Fujitsu SCSI	Call
650MB	Panisonic PD combination optical & 4X CD ROM	Call
2.6Gig	Maxoptix Int/Ext	$1925/$2025
2.6Gig	HP Int/Ext	$2125/$2225

SYQUEST DRIVES

EZ 135MB •13.5ms, 3600rpm, 128K buffer, 3 1/2" drive

Internal IDE with disk / External SCSI with disk	$190/$199
External parallel port with 1 disk	$249
NEW 230MB Flyer	**$299**

270MB • 13.5ms, 3600rpm, 128K buffer, 3 1/2" drive

Internal IDE (SQ3270A)/ with 1disk (S3270AC)	$299/$339
External for parallel port with 1 disk	$429
SCSI drive (SQ3270S)/SCSI external(S3270X)	$339/$399

200MB •15.7ms, 3220rpm, 64K buffer, 5 1/4" form factor.

SCSI drive (SQ5200)/SCSI external(SQ5200CX)	$339/$399

IOMEGA DRIVES

100MB ZIP • 3.5" x 1" high form factor

External SCSI w/ 1 disk	$195
Parallel External w/ 1 disk	$195

1 Gig JAZ • 3.5" x 1" high form factor

Internal SCSI w/ 1 disk	$489
External SCSI w/ 1 disk	$589

Adaptec controller A1505CDKIT only $49 when purchased with Zip or Jaz drive.

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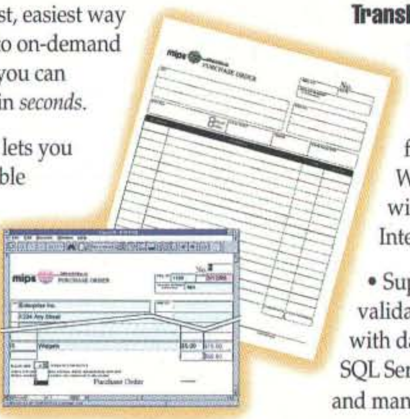

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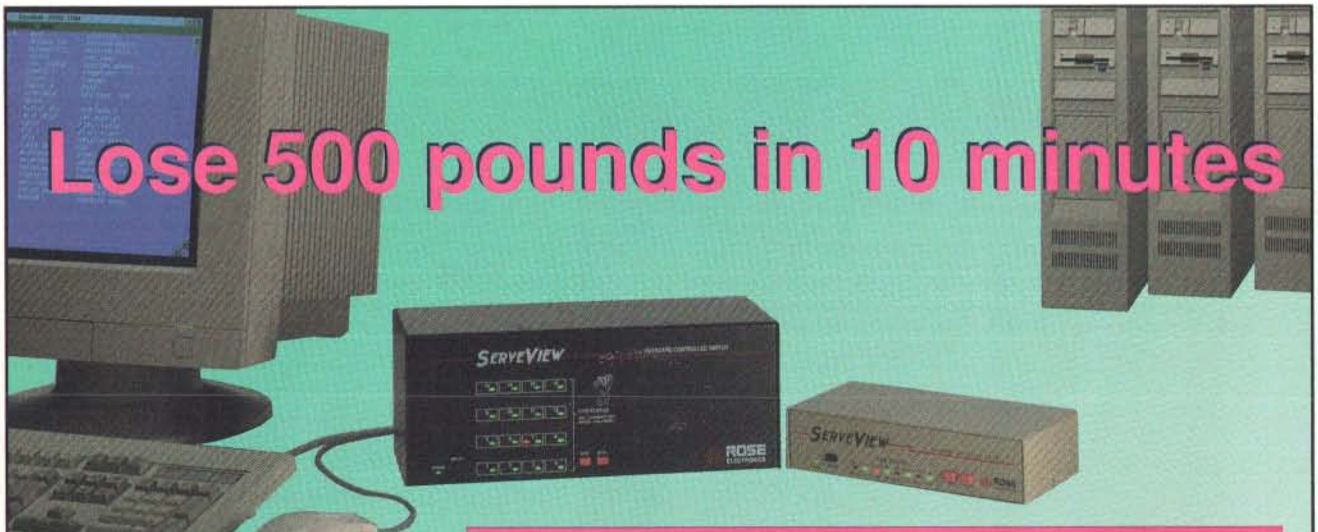

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HARD DRIVES

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FIREBALL SERIES-3 YEAR WAR.				INT-EXT
1080S	1.08GB	12MS	Fast SCSI-2	$269-394
1280A	1.2GB	11MS	Fast-ATA-2 (IDE)	225-375
1280S	1.2GB	11MS	Fast SCSI-2	315-440
TRAIL BLAZER SERIES-3 YEAR WAR.				**INT-EXT**
850A	850MB	14MS	Fast-ATA-2 (IDE)	193-343
ATLAS SCSI 2 SERIES-5 YEAR WAR.				**INT-EXT**
XP31250S	2.1GB	8MS	Fast SCSI-2	649-774
XP31250W	2.1GB	8MS	Fast Wide SCSI-2	649-774
XP34300S	4.3GB	8MS	Fast SCSI-2	969-1094
XP34300W	4.3GB	8MS	Fast Wide SCSI-2	969-1094
BIG FOOT SERIES-3 YEAR WAR.				**INT-EXT**
1280A	1.2GB	15MS	Fast-ATA-2 (IDE)	219-369
2577A	2.5GB	15MS	Fast-ATA-2 (IDE)	389-539
SIROCCO SERIES-3 YEAR WAR.				**INT-EXT**
1708A	1.7GB	11MS	Fast-ATA-2 (IDE)	299-449
2550A	2.5GB	11MS	Fast-ATA-2 (IDE)	399-549

WESTERN DIGITAL

FACTORY NEW-3 YEAR WARRANTY				INT-EXT
WDAC2850	850MB	10MS	IDE	$183-333
WDAC21200	1.2GB	10MS	IDE	205-355
WDAC31600	1.6GB	10MS	IDE	249-399
WDAC32100	2.1GB	10MS	IDE	310-460
WDAC32500	2.5GB	10MS	IDE	350-500

HEWLETT PACKARD

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
C3725S	2.1GB	9.5MS	SCSI	$495-659

NOTEBOOK HARD DRIVES

TOSHIBA

NOTEBOOK DRIVES/1 YEAR WARRANTY ON 2.5"				
MK1924FCB	524MB	15MS	IDE	$250
MK1926FCV	810MB	13MS	IDE	320
MK2720FC	1.3GB	13MS	IDE	510

IBM

IBMHDN520	520MB	IDE	$300

Seagate

NOTEBOOK DRIVES/1 YEAR WARRANTY ON 2.5"				
MK1924FCB	524MB	15MS	IDE	$250
MK1926FCV	810MB	13MS	IDE	320
MK2720FC	1.3GB	13MS	IDE	510

FLOPPY DRIVES

TEAC/NEC

1.44MB, 3.5"/ w/brackets	$35-42
1.2MB, 5.25"	45
DUAL FLOPPY 1.44MB & 1.2MB	99

MITSUMI

1.44MB,3.5" / w/brackets	$28-35

SCSI & CPU CASES

Half Ht, 3.5"IDE Drives parallel port	$148
Half Ht, 5.25" or 3.5" Devices (1Bay) SCSI	89
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5.25" Full Ht, (1) FH or (2) HH Devices (2 Bay) SCSI	149
5.25" Double Full Ht,(2) FH Devices (4 Bay) SCSI	249
5.25" 3-Full Ht & 1HH or 7HH Devices (7 Bay) SCSI	349
3.50" HH (4Bays) 3.5" Devices SCSI	299
DESKTOP CASE, 230 w/ps 4 Bays	65
MINI TOWER, 230 w/ps 5 Bays	65
MID TOWER, 230 w/ps 6 Bays	95
FULL TOWER, 230 w/ps 7 Bays	125
SUPER TOWER, 300 w/ps 9 Bays	250

CONNER

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
CFS1081A	1.3GB	14MS	IDE	$196-246
CFS1275A	1.3GB	14MS	IDE	207-336
CFS1621A	1.6MB	14MS	IDE	257-407
CFP2107S	2.1GB	9MS	SCSI-2	644-769
CFP4207S	4.2GB	9MS	SCSI-2	925-1050

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
MC4221	2.05GB	8.5MS	SCSI-2	$549-699
MC4421	2.1GB	9MS	SCSI-2	449-574
MC1936	3.0GB	11MS	SCSI-2	750-999
MC3243	4.3GB	8MS	SCSI-2	859-984
MC1991	9.1GB	10MS	SCSI-2	1839-1964
MC4221AV	2.05GB	8.5MS	SCSI-AV	599-649
MC3243AV	4.3GB	8.5MS	SCSI-AV	949-1099
MC1991AV	9.1GB	10MS	SCSI-AV	1959-2140

Maxtor

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
M71336A	1.3GB	12MS	IDE	$200-350
M71626A	1.6GB	12MS	IDE	249-399
M72004A	2.0GB	12MS	IDE	289-439
M72504A	2.5GB	12MS	IDE	350-500

FUJITSU

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
M1614T	1.1GB	11MS	IDE	$185-335
M1638T	2.5GB	9.5MS	IDE	349-499
M1638S	2.2GB	10MS	SCSI	469-619
M2934S	4.3GB	10MS	SCSI	869-994

REMOVABLES/OPTICALS

SYQUEST

REMOVABLE CARTRIDGE DRIVES	
EZ135 135MB IDE Internal	$187
EZ135 135MB SCSI External	199
EZ135 135MB Parallel Port	221
EZ135 135MB Cartridge	20
270MB SCSI INTERNAL	375
270MB SCSI EXTERNAL	495
270MB CART. SINGLES/5 PACK	55-270
270MB INT. IDE	375

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230MB 3.5" OPTICAL DRIVE INTERNAL	$499
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230MB CARTRIDGE 1-PACK $35 5-PACK	170

IOMEGA

ZIP Drive 100MB Parallel Port	$199
ZIP Drive 100MB SCSI	199
Ditto Easy 800MB Travan Tape Drive, Int.	119
Ditto Easy 800MB Travan Tape Drive, Ext.	149
Jaz Drive 1GB Internal SCSI-II	499
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Jaz Drive 1GB Cartridge	124

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MicroSolutions

BACKPACKS	
4 SPD PARALLEL PORT CD ROM DRIVE	$245
DISKETTE DRV 1.2MB, 5.25 EXT	175
DISKETTE DRV 1.4MB, 3.5 EXT	175
800TD BACKPACK 800MB TAPE DRIVE	155
BACKPACK 420MB HARD DRIVE	469

COLORADO MEMORY SYSTEMS

1534 2.0GB TAPE INT/EXT	$662-762
1536 4GB TAPE INT/EXT	789-899
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4MM 90MT DAT CART (1/5 PK)	12-55
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4MM 90MT DAT CART (1/5 PK)	12-55
4MM 120MT DAT CART (1/5PAK)	35-170
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EXABYTE

A4200I 2GB TAPE INTERNAL	$699
4200I 2GB TAPE EXTERNAL	850
8205XL 3.5-7GB TAPE INT/EXT	1276-1449
8505XL 7-14GB TAPE INT/EXT	1998-2298

IOMEGA

Bernoulli 230MB Insider SCSI	$474
Bernoulli 230MB Transportable SCSI	525
90 MB/150MB/230MB Cartridge	99

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HEWLETT PACKARD 2.1GB SCSI C3725S 9.5MS **$495**

DRIVE BLOWOUTS!

SEAGATE 420MB IDE 11MS ST3491A **$169**

QUANTUM 540MB SCSI 12MS LT540S **$175**

IBM STANDARD & PS2

DESKSTAR-3 YEAR WARRANTY			INT-EXT
1.1GB	10.5MS	IDE	$269-419
1.7GB	12MS	IDE	329-479
ULTRASTAR FAST SCSI-2 5 YEAR WARR			
2.1GB	7.5MS	Fast SCSI-2	1049-1199
4.5GB XP	8MS	Fast SCSI-2	1499-1649
ULTRASTAR FAST WIDE SCSI-2 5 YEAR WARR			
2.1GB	7.5MS	Fast Wide SCSI-2	1049-1199
4.5GB XP	8MS	Fast Wide SCSI-2	1499-1649
PS/2 50, 50Z, 60, 70, 80, P70, 55SX			
630MB	12MS	IDE	399
1.2GB	12MS	IDE	449
1.2GB	12MS	SCSI	499
MICROCHANNEL CONTROLLER			
IDE	169	SCSI-2	179
IBM PS/2 INTERNAL DRIVE KITS 30-8086,30-286,25-8086, 25-286			
630MB		IDE	349
1.2GB		IDE	399

Seagate

FACTORY NEW 1-5 YEAR WARRANTY				INT-EXT
ST3491A	420MB	14MS	IDE	$165-315
ST3630A	631MB	14MS	IDE	169-319
ST3850A	850MB	11MS	IDE	195-345
ST51080A	1.05GB	10.5MS	IDE	195-335
ST51270A	1.3GB	10.5MS	IDE	205-355
ST31640A	1.6GB	10.5MS	IDE	275-425
ST32140A	2.2GB	10MS	IDE	295-445
ST51080N	1.08GB	10.5MS	SCSI-2	285-435
ST31051N	1.05GB	9MS	SCSI-2	349-474
ST32430N	2.1GB	9MS	SCSI-2	575-700
ST32151N	2.1GB	9MS	SCSI-2	595-720
ST43400N	3.0GB	11MS	SCSI-2	545-695
ST15230N	4.2GB	9MS	SCSI-2	899-1049
ST410800N	9.0GB	11MS	SCSI-2	1879-2029
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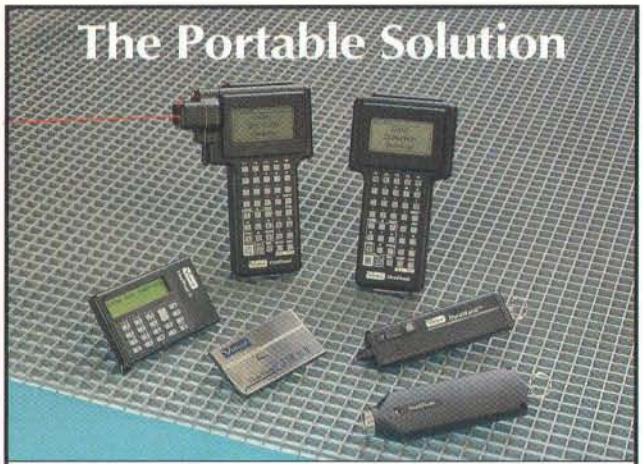

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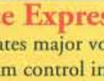

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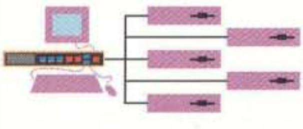

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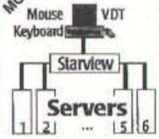

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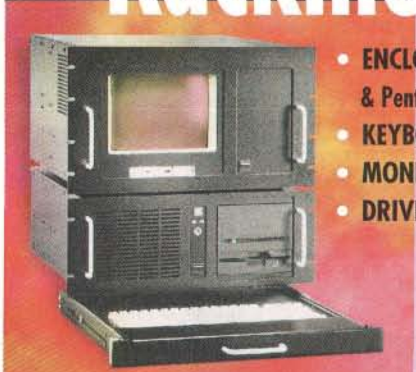

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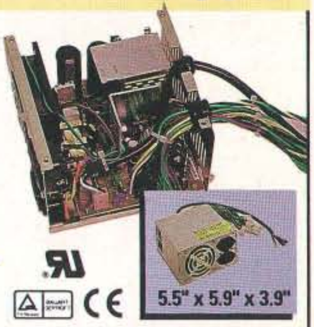

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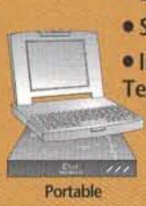

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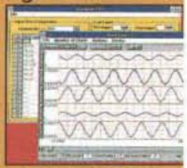

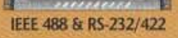

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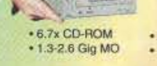

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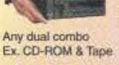

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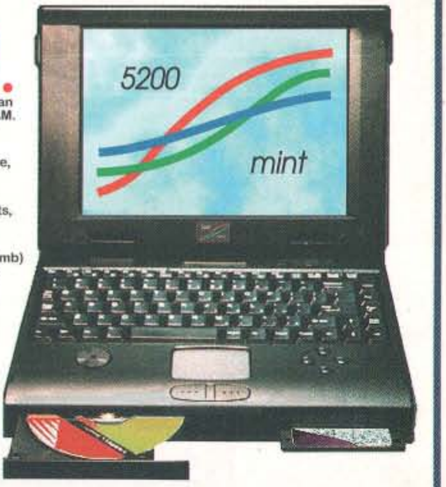

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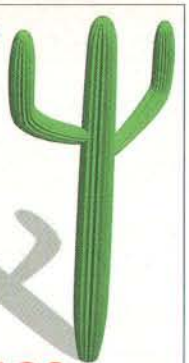

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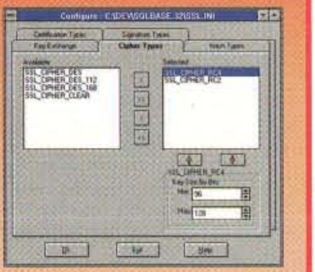

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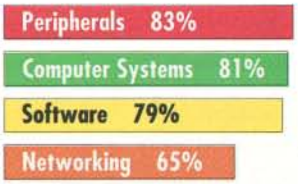

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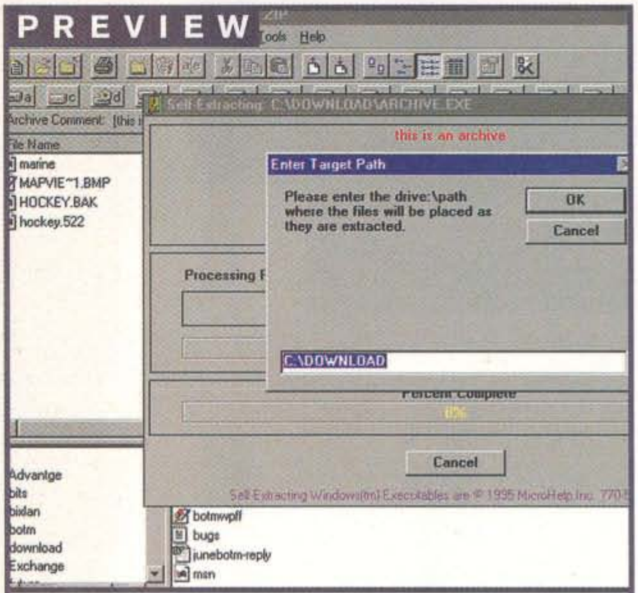
What's New

PREVIEW



Please enter the drive:\path where the files will be placed as they are extracted.

C:\DOWNLOAD

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A Helpful Windows Compression Utility

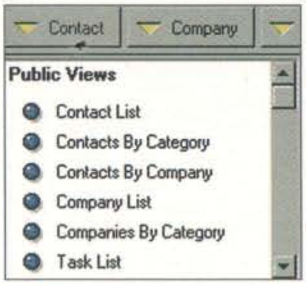
Whether you're backing up files or sending and receiving e-mail, sooner or later you'll need to compress and decompress your files. Several utilities on the market help you manage files that are compressed using the popular ZIP file format, but a new one from MicroHelp also addresses other formats that you may encounter on the Internet, such as TAR, G-zipped TAR, UUencode, and LZW. You can also UUencode files.

MicroHelp's Zip saves time in zipping up files for zapping over the Internet with its built-in Explorer interface. This lets you browse your PC and network directories from within the Zip Explorer instead of having to open the Windows 95 Explorer and drag and drop files to a new archive. Zip's time-saving interface lets you drag and drop files directly into a new archive.

Once you've created a new archive of compressed files, Zip's options make it easy for the person who receives your compressed files. You can build a self-extracting archive with a variety of options for the archive recipient, including prompting the user for a destination path prior to extraction (see the screen), automatic overwriting of files during extraction, and others. Other features of the program include support for backing up compressed files and the ability to view, edit, and run downloads without unzipping the archive. Whether you use Win 3.1 or Win 95 (MicroHelp Zip supports both), this compression utility is worth checking out. **–Dave Andrews**

Business

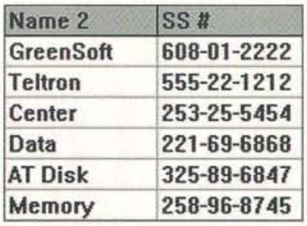
Lotus Notes Version of Act



ACT FOR NOTES (SINGLE-NODE CD-ROM, $249.95; 10-node license pack, $2250) helps workgroups and individual workgroup members manage contacts, activities, notes, history, and correspondence. Through Lotus Notes, Act for Notes supports multiuser databases, document-level security, and database replication.
Contact: Symantec Corp., Cupertino, CA, (800) 441-7234 or (541) 334-6054; http://www.symantec.com.
Circle 1029 on Inquiry Card.

Windows Forms Automation

NOW YOU CAN CONVERT SCANNED AND faxed forms into reusable data-entry templates for printing, sharing, and reusing. GreenForm ($99.95) lets you use TrueType, ATM, and Windows fonts; color images; bit maps; signatures; and logos in forms. The program links data to forms via a scrollable table. You can import data into the table for merging with forms and export data as text for use in software programs, such as databases.



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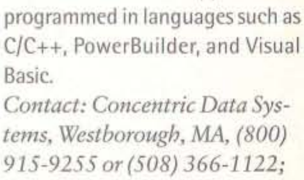
Teltron	555-22-1212
Center	253-25-5454
Data	221-69-6868
AT Disk	325-89-6847
Memory	258-96-8745

Contact: GreenSoft Corp., Camarillo, CA, (800) 588-3375 or (805) 388-1700; http://www.greendesk.com.
Circle 1030 on Inquiry Card.

Business Information Publishing Toolkit

BASED ON WALL DATA'S ACTIVEX ARchitecture for the 32-bit Windows desktop, Arpeggio Viewer ($150 per user), Arpeggio for the Desktop ($500 per user), and Arpeggio for the Developer ($650 per user) provide an integrated solution for database access, query, data transfer, report generation, and information publishing across an enterprise network. You can integrate data access and publishing capabilities into custom applications programmed in languages such as C/C++, PowerBuilder, and Visual Basic.

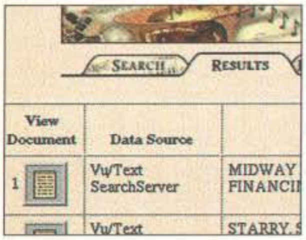


Contact: Concentric Data Systems, Westborough, MA, (800) 915-9255 or (508) 366-1122; http://www.walldata.com.
Circle 1031 on Inquiry Card.

Software Search Suite

INTERMEZZO (FROM $20,000, DEPENDING on configuration) combines a text-search engine, an image-search engine, NameTag Automatic Indexing software, a Mac or Windows client API, and a Netscape interface

ISDN seems to be experiencing a resurgence of interest, and we're seeing an increasing number of product announcements for it. Meanwhile, the parade of products for the Web continues.



View Document	Data Source	
1	Vu/Text SearchServer	MIDWAY FINANCI
	Vu/Text	STARRY.S

for enterprise-wide, multimedia access to heterogeneous information. After you build queries, Intermezzo translates them into the native search formats of selected databases and distributes them to search servers. Databases can be local to a client, accessible on LANs and WANs via TCP/IP, or Internet-accessible through Z39.50.
Contact: SRA International, Arlington, VA, (800) 511-6398 or (703) 558-4700; http://www.sra.com.
Circle 1032 on Inquiry Card.

CAD

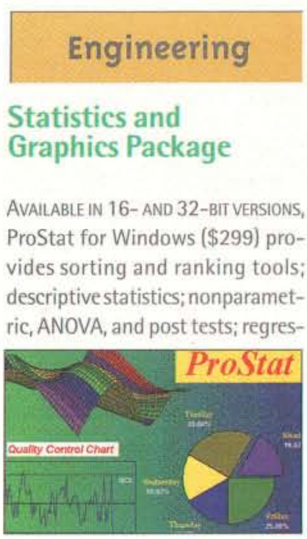
AutoCAD LT for Windows 95

Now you can exchange data with Windows applications that support OLE. AutoCAD LT for Windows 95 (about $469) provides OLE 2.0 container and server support. It also allows you to create electronic files from paper drawings; use a template to input data; and create, edit, and import large bodies of text. In addition, you can graphically view the effects of changes while you're creating or modifying text styles; see a thumbnail view before opening your drawing; copy all or a subset of one object's properties to another object; and run several sessions of AutoCAD LT simultaneously on the same machine.
Contact: Autodesk, Inc., San Rafael, CA, (800) 228-3601 or (415) 507-5000; http://www.autodesk.com.
Circle 1033 on Inquiry Card.

Engineering

Statistics and Graphics Package

Available in 16- and 32-bit versions, ProStat for Windows ($299) provides sorting and ranking tools; descriptive statistics; nonparametric, ANOVA, and post tests; regression, correlation, control-factor, and cluster analysis; time series; mathematical transformations; numerical integration and differentiation; and fast Fourier transforms. You can exchange data to and from most file formats and export graphs into popular graphics formats.
Contact: Poly Software International, Salt Lake City, UT, (801) 485-0466; http://www.polysoftware.com.
Circle 1034 on Inquiry Card.



Architectural Modeling

Available for DOS and Windows on Intel-based systems as well as on DEC Alpha AXP, Power Mac, and SGI machines, MicroStation TriForma ($5325) provides 3-D conceptual modeling and automatic generation of drawings, specifications, and cost estimates. The single-building model integrates architectural structures, parametric doors, windows and openings, walls and cavity walls, floors, roofs, parametric stairs, and construction materials.
Contact: Bentley Systems, Inc., Exton, PA, (800) 236-8539 or (610) 458-5000; http://www.bentley.com/.
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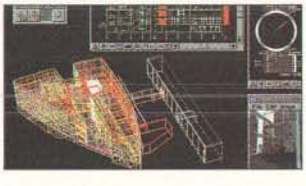


Six AEC CD-ROMs

Softdesk's six Special Edition CD-ROMs provide AutoCAD applications for particular architectural, engineering, and construction disciplines. They include the Softdesk Civil/Survey Special Edition II CD ($6000); the Softdesk Architectural Special Edition CD ($3000); the Softdesk Building Services Special Edition CD ($3000); the Softdesk Imaging Special Edition CD ($3000); the Softdesk Structural Special Edition CD ($3000); and the Softdesk Process & Power Special Edition CD ($3000).
Contact: Softdesk, Inc., Henniker, NH, (800) 763-8337 or (603) 428-5267; http://www.softdesk.com.
Circle 1036 on Inquiry Card.

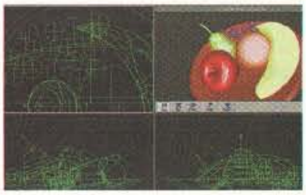
The Web

Web-Based Client/Server Applications

Using the WebCrusader software family (from $75), you can combine Web browsers with mission-critical information-systems (IS) applications to create secure, real-world intranets. The core components include desktop-to-database security, high reliability and redundancy, authentication and privacy, audit trails, high availability, access control, management for large networks, and location transparency.
Contact: Gradient Technologies, Inc., Marlborough, MA, (800) 525-4343 or (508) 624-9600; http://www.gradient.com.
Circle 1037 on Inquiry Card.

VRML Authoring Tool

SiteSculptor ($49.95) helps you build VRML worlds for home pages on the World Wide Web. The Windows program offers 3-D modeling tools, such as true CAD solid modeling, NURBS surface creation, and Boolean operations, and authoring tools, such as light sources, texture mapping, and a texture-materials library. Support for DXF and polygonal file data-translation capabilities lets you incorporate graphics from other design programs, as well as SPIN and ANIMATE controls.
Contact: Cadkey, Inc., Windsor, CT, (800) 395-3208 or (860) 298-8888; http://www.cadkey.com.
Circle 1039 on Inquiry Card.



Web-Server Software

With Webworx ($999), you can create basic Web pages, database-interactive Internet Web sites, and Internet service providers, all from a single PC. The package includes the Linux OS; HTTP Web-server software with CGI and multiple domain-name capability; the Perl programming language; C/C++ compilers; programming utilities;

other languages; and Web-browser software that supports HTML and other Internet protocols.
Contact: WorkGroup Solutions, Inc., Aurora, CO, (303) 693-3321; http://www.wgs.com.
Circle 1038 on Inquiry Card.

Utilities

Boost CD-ROM Performance

CD-ROM Express ($79.95) employs hard disk space to store frequently used CD-ROM sectors. Because disk storage is nonvolatile, the program can also preserve these sectors from one session to another. The program, for use with DOS and Windows, tunes itself to your hardware, applications, and usage patterns and coexists with Microsoft SmartDrive and other hard disk caches. In addition, the software is compatible with SCSI, IDE, and proprietary one-, two-, three-, quad-speed, and faster CD-ROM drives.
Contact: PC-Kwik Corp., Beaverton, OR, (800) 274-5945 or (503) 644-5644; http://www.teleport.com/~gnome/pckwik.htm.
Circle 1040 on Inquiry Card.

Software Docking Station

SoftDock (about $124.95) provides transparent access to network files and applications even when you aren't connected to the network. The program is protocol independent, and it works with major network OSes (NOSes). While you are docked, SoftDock checks the server to make sure that replicated files are current. If you modify network files while undocked, the SoftDock program automatically synchronizes the client and the server when you redock.
Contact: NetStream, Inc., Carnegie, PA, (412) 276-9600; http://www.netstream.com.
Circle 1041 on Inquiry Card.

SOFTWARE UPDATE

An ActiveX control for creating, editing, viewing, and printing diagrams, **InterAct 1.5** provides an expandable palette with default shapes, lines, and arrows; and Internet support, which lets you design diagrams that let users navigate and jump to Web pages and associate Web pages with entities in a diagram. As a 16/32 DLL or 16/32 OCX, $395 each; as a 16/32 DLL and OCX, $495.
Contact: ProtoView Development Co., Cranbury, NJ, (800) 231-8588 or (609) 655-5000; http://www.protoview.com.
Circle 1042 on Inquiry Card.

A program for integrating text and mathematics, **Scientific WorkPlace 2.5** provides a Mathematica link, 32-bit processing under Windows 95 or NT, a Multiple Document Interface (MDI), a new style editor, hypertext links, and support for Western European and some Eastern European languages. CD, $595; floppy, $630.
Contact: TCI Software Research, Las Cruces, NM, (800) 874-2383 or (505) 522-4600; http://www.tcisoft.com/tcisoft.html.
Circle 1043 on Inquiry Card.

The **TK Solver Release 3** mathematical modeling software offers OLE 2.0 support for linking and integrating TK objects with Microsoft Office documents; external function calls; Wizards; and a Greek character palette. $299.
Contact: Universal Technical Systems, Inc., Rockford, IL, (800) 435-7887 or (815) 963-2220; http://www.uts.com.
Circle 1083 on Inquiry Card.

HARDWARE

Accessories

Cordless Mouse with Customizable Buttons

Designed for use with Windows 3.x and 95, RemotePointPlus is an infrared pointing device with three system components: a cordless, hand-held transmitter; an infrared receiver; and the VersaPointPlus Windows software. In addition to 360-degree cursor control and dual click-button support, RemotePointPlus ($199.95) provides four customizable buttons to give you one-touch, on-the-fly access to up to 15 user-assigned presentation tools, software launches, and media effects.

Contact: Interlink Electronics, Camarillo, CA, (800) 340-1331 or (805) 484-1331; http://www.interlinkelec.com.
Circle 1045 on Inquiry Card.

Point-and-Shoot Digital Camera

The PowerShot 600's (about $949) 570,000-pixel CCD sensor produces a 24-bit image in 16.7 million colors at an optical resolution of 832 by 608. The digital camera uses a Canon auto-focus f/2.5 7.5mm lens and offers through-the-lens autofocusing and a built-in automatic flash from 8 inches to 12 feet. In place of conventional film, the PowerShot 600 uses 1 MB of internal memory to store up to 18 images and can store up to 72 images with an optional 4-MB compact flash memory PC Card.
Contact: Canon Computer Systems, Inc., Costa Mesa, CA, (714) 438-3000; http://www.ccsi.canon.com.
Circle 1046 on Inquiry Card.

Desktop Surge Protection

A desktop power-control device, the Switcher 2000 Plus ($49.99) provides protection-status indication, recessed power switches, three-line fusing, and six protected outlets, one of which is unswitched for devices that need continuous power.
Contact: Newpoint Corp., San Diego, CA, (800) 639-7646 or (619) 677-5700.
Circle 1047 on Inquiry Card.

Communications

ISDN Communications for the Home Office

A digital communications manager, Front Desk ($1395) equips your home office with the capabilities of PBX-level call handling, call routing, voice mail, remote access to faxes, single-number "find me" capabilities, and high-speed data communications. Call-handling capabilities include two simultaneous voice, fax, or data calls; up to 16 phone numbers; caller ID; call screening; call waiting; and up to eight office modes. Voice/fax messaging features include up to 10 mailboxes, up to 30 minutes of voice-message storage, up to 40 pages of fax storage, and remote voice/fax message retrieval.

Contact: Jetstream Communications, Inc., San Jose, CA, (408) 777-4300; http://www.jetstream.com.
Circle 1048 on Inquiry Card.

LAN/Modem PC Card

Designed for mobile computers that are equipped with a Type II PC Card expansion slot, the PCMCIA LAN-modem Card ($499) allows con-

I was frustrated with USENET

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preoccupied by who has the most users online; I want to be treated as a person, not a statistic.

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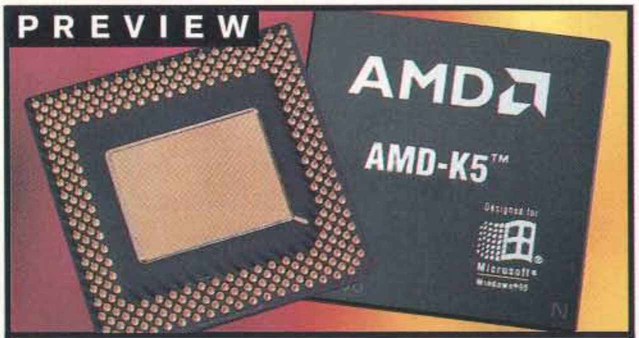


AMD 5K86-P75
$75

Circle 1044
on Inquiry Card.

AMD, Inc.
Austin, TX
(800) 222-9323
(512) 385-8542
http://www.amd.com

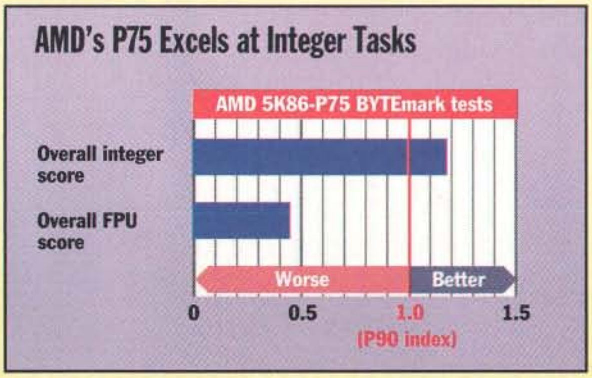
The K5's Debut

A 75-MHz version of AMD's long-awaited Pentium competitor, code-named the K5 and now officially called the AMD5K86-P75, came to BYTE housed in a generic, midrange office system. To test the widely held prediction that AMD's chip would run 30 percent faster than a same-speed Pentium, and to see how its shrunken die size (resulting from AMD's new 0.35-micron process) effects this prediction, we ran our BYTEmark CPU tests. The 5K86-P75's integer score, 20 percent faster than that of a 90-MHz Pentium–44 percent faster when factoring in the speed difference–confirmed the prediction. Its integer scores are on par with those of a P90, although all the FPU-based results lag by more than half (see the figure below).

Touted as a fifth-generation CPU, the 5K86's superscalar, superpipelined design also has sixth-generation traits, including a quad-issue pipeline with six parallel execution units and a four-way CISC/RISC decoder unit; out-of-order and speculative execution; dual reservation stations for each execution unit except the FPU; and register renaming. (For more architectural details, see "CPU Scorecards," November 1995 BYTE, and "AMD vs. Superman," November 1994 BYTE.) Soon after the chip's release in late April, AMD already had a respectable list of K5 customers, including Acer, Atrend, CyberMax, Epson, ICL, and Luiski.

With Windows 95 hardware certification, a standard P54C pinout, a compelling price ($75 for the AMD-P75 and $99 for the AMD-P90, versus $106 for 75-MHz Pentiums and $134 for P90s), and plans to ship 100-, 133-, and 150-MHz versions by the end of the year, AMD may finally enjoy some of the waning low-end Pentium corporate market. **–Selinda Chiquoine**

AMD's P75 Excels at Integer Tasks



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current operation of a 10Base-T Ethernet LAN adapter with a V.34 fax modem. The 10Base-T Ethernet adapter is IEEE 802.3 compliant and supports speeds up to 10 Mbps. The modem supports data speeds up to 28.8 Kbps (with V.42bis compression) and fax speeds up to 14.4 Kbps.
Contact: Linksys, Irvine, CA, (800) 546-5797 or (714) 261-1288; http://www.linksys.com.
Circle 1049 on Inquiry Card.

Direct-Connect PC Card Phone Jack

NOW CONNECTING YOUR PORTABLE TO A phone line is as simple as popping open SimpleJack on the 28.8 Communicator and plugging in a standard RJ-11 phone cord. The 28.8 Communicator with SimpleJack ($279) provides MNP 10-EC and TX-CEL cellular-correction technology for calling over a cell phone. Communications software for Windows 3.1 and 95 allows you to access the Internet as well as send and receive faxes and data.
Contact: Simple Technology, Santa Ana, CA, (800) 474-6753 or (714) 476-1180; http://www.simpletech.com.
Circle 1050 on Inquiry Card.

Videoconferencing Fax Modem

WITH THE SMARTLINK MWAVE DOCUPAL V.34 multimedia DSVD fax/modem ($439), two or more users can view and revise the same document onscreen simultaneously from various workstations. The modem can transmit data at speeds up to 28.8 Kbps, with maximum throughput up to 115.2 Kbps. It also offers a full-featured phone and digital answering machine with remote message retrieval. Sound Blaster–compatible audio/MIDI functions support music, voice-over, and 3-D effects.
Contact: Archtek America Corp., City of Industry, CA, (818) 912-9800; http://www.archtek.com.tw.
Circle 1051 on Inquiry Card.

ISDN PC Card

THE DIVA T/A (TERMINAL/ADAPTER) PC Card ($495) combines ISDN communications at speeds up to 128 Kbps with a plug-in modem for PCs and Macs. The card provides an ISDN Basic Rate Interface with two B channels and one D channel, supporting full COM-port speeds up to 128 Kbps with concurrent use of both B channels. The card supports PPP and SLIP and, with rate adaptation, it can also handle asynchronous protocols.
Contact: Eicon Technology, Inc., Dallas, TX, (214) 239-3270; http://www.eicon.com.
Circle 1052 on Inquiry Card.

External Modems

AVAILABLE IN LED AND LCD MODELS, Quicktel II modems include internal speakers, internal microphones, and jacks for external speakers and microphones. The modems include the V.34 DSVD/Speakerphone modem (LED version, $349; LCD version, $399) and the V.34 Speakerphone/Data/Fax/Voicemail modem (LED model, $299; LCD model, $349).
Contact: Logicode Technology, Inc., Camarillo, CA, (800) 735-6442 or (805) 383-2500; http://www.logicode.com.
Circle 1053 on Inquiry Card.

Multimedia

Multimedia Upgrade Kit for Laptops

WITH THE PORTASCSI MULTIPORT PORtable Multimedia Kit (battery-operated version, about $599; PC-powered version, about $499), you can add a quad-speed CD-ROM, a 16-bit audio PC Card adapter, and speakers to your laptop or notebook PC. The kit is MPC-II compliant and has a dedicated bus for the

CD-ROM drive for smoother multimedia playback.
Contact: Portable Systems Solutions, Inc., Phoenix, AZ, (602) 437-9103; http://www.portascsi.com.
Circle 1054 on Inquiry Card.

Peripherals

"Portable" SVGA Projector

The LitePro 620 ($10,000 to $12,000) features Texas Instruments' Digital Light Processing technology, a Harman International JBL audio system, the Kodak Color Matching System, and modular architecture. The 21-pound projector has a resolution of 800 by 600 pixels, and it supports full-motion video with a contrast ratio of 125:1 and NTSC, PAL, and SECAM video standards. The unit's Smart Remote features backlit buttons for controlling a PC or Mac from up to 40 feet away, and the CableWizard allows you to easily connect your computer, audio, mouse, and monitor loop-through to the LitePro 620.
Contact: In Focus Systems, Inc., Wilsonville, OR, (800) 294-6400 or (503) 685-8888; http://www.infs.com.
Circle 1055 on Inquiry Card.

10X CD-ROM Drive

With its internal 5¼-inch, half-height form factor, the 10Xtreme ($299) IDE CD-ROM drive has a 1.5-MBps data rate, a 650-MB capacity per disk, a 300,000-page text capacity, a 1000- to 40,000-image capacity, a 1- to 48-hour audio capacity, and a 1- to 5-hour video capacity.
Contact: Pinnacle Micro, Inc., Irvine, CA, (800) 553-7070 or (714) 789-3000; http://www.pinnaclemicro.com.
Circle 1056 on Inquiry Card.

Convertible Printer

The MultiPass C2500 (about $599) starts with bubble-jet printing and combines plain-paper faxing, 200-dpi monochrome scanning, 360-dpi copying, and PC fax capabilities in one product. You get 720- by 360-dpi four-color printing on a variety of media, as well as up-to-5-ppm monochrome printing.
Contact: Canon Computer Systems, Inc., Costa Mesa, CA, (800) 848-4123 or (714) 438-3000; http://www.ccsi.canon.com.
Circle 1057 on Inquiry Card.

Write CDs with Your Mac

An external CD-Recordable drive for the Mac, the CDMaker ($1095) lets you write your own CDs on a 650-MB CD. The product features 300-KBps transfer rates and supports single-session, multisession, and track-at-once writing methods.
Contact: CMS Enhancements, Inc., Anaheim, CA, (800) 327-5773 or (714) 517-0915.
Circle 1058 on Inquiry Card.

Up to 56 CD-ROMs on One Host Adapter

MDI's eight-high CD-ROM towers ($4095 to $5095) come with quad- or six-speed drives and SCSI Express software. The towers offer up to 1000-KBps data transfer rates, a 135-ms random-access time, a 120-ms random-seek time, and a 256-KB buffer, based on drive selection. They support CD-XA, CD-I, Video CD, and Multisession Photo CD and run in Novell, OS/2, Windows NT, and Mac environments.
Contact: Micro Design International, Inc., Winter Park, FL, (407) 677-8333; http://www.microdes.com.
Circle 1059 on Inquiry Card.

2-MB PocketJet Printer

The latest PocketJet portable printer supports letter- and legal-size page printing and comes with 2 MB of memory. The direct thermal-print technology produces 300- by 300-dpi text and graphics. LaserJet IIP (PCL4) emulation enables you to print most Windows, OS/2, and DOS applications. The 2-MB PocketJet can print up to 3 ppm, depending on paper size and print density, and up to 35 pages on a full battery charge. The Letter/Legal/2-MB PocketJet print system kit ($649) includes a rechargeable nicad battery, a universal AC adapter/charger, a parallel interface cable, a printer carrying case, and letter-size thermal paper.
Contact: Pentax Technologies Corp., Broomfield, CO, (800) 543-6144 or (303) 460-1600; http://www.pentaxtech.com.
Circle 1060 on Inquiry Card.

Systems

200-MHz Quad Pentium Pro Servers

You can configure the ALR Revolution Quad6 200/256 with up to four Intel Pentium Pro processors for high-traffic, enterprise-wide server applications. Available with a 166- or a 200-MHz processor, the Revolution Quad6 incorporates 64 MB of ECC RAM, expandable to 2 GB; a 1-MB PCI graphics adapter; EISA-bus technology; and a dual PCI bus. The floor-standing tower (from $14,495) offers 15 expansion slots; a double-wide chassis with 13 externally accessible storage bays; and ALR InforManager, which safeguards system operation by monitoring and reporting key operational data. The rack-mountable server (from $16,495) includes five shared PCI/EISA slots, redundant power supplies, 12 drive bays, and ALR InforManager.
Contact: ALR, Inc., Irvine, CA, (800) 444-4257 or (714) 581-6770; http://www.alr.com.
Circle 1061 on Inquiry Card.

Business Desktop and Minitower PCs

The AcerPower systems come with 100- to 166-MHz Intel Pentium processors; Triton II PCI chip sets; 8/16 MB of EDO DRAM; 256 KB of pipeline burst cache; 1.2- to 2.0-GB hard drives; 2/4 MB of video memory or 0.5 MB of DRAM; Desktop Management Interface support; and Windows 95, NT, or Windows for Workgroups. The desktop chassis (from about $1275 to $2750) contain three ISA and two PCI expansion slots and four storage bays. The minitower chassis (from about $1350 to $3225) contain three ISA and four PCI expansion slots and seven storage bays. Options include 15- and 17-inch monitors, eight-speed CD-ROM drives, and a 16-bit Creative Labs sound card.
Contact: Acer America Corp., San Jose, CA, (800) 733-2237 or (408) 432-6200; http://www.acer.com/aac/.
Circle 1062 on Inquiry Card.

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Mitsubishi
Personal Mobile
Communications
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http://www
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UPLink Client and
UPLink Server
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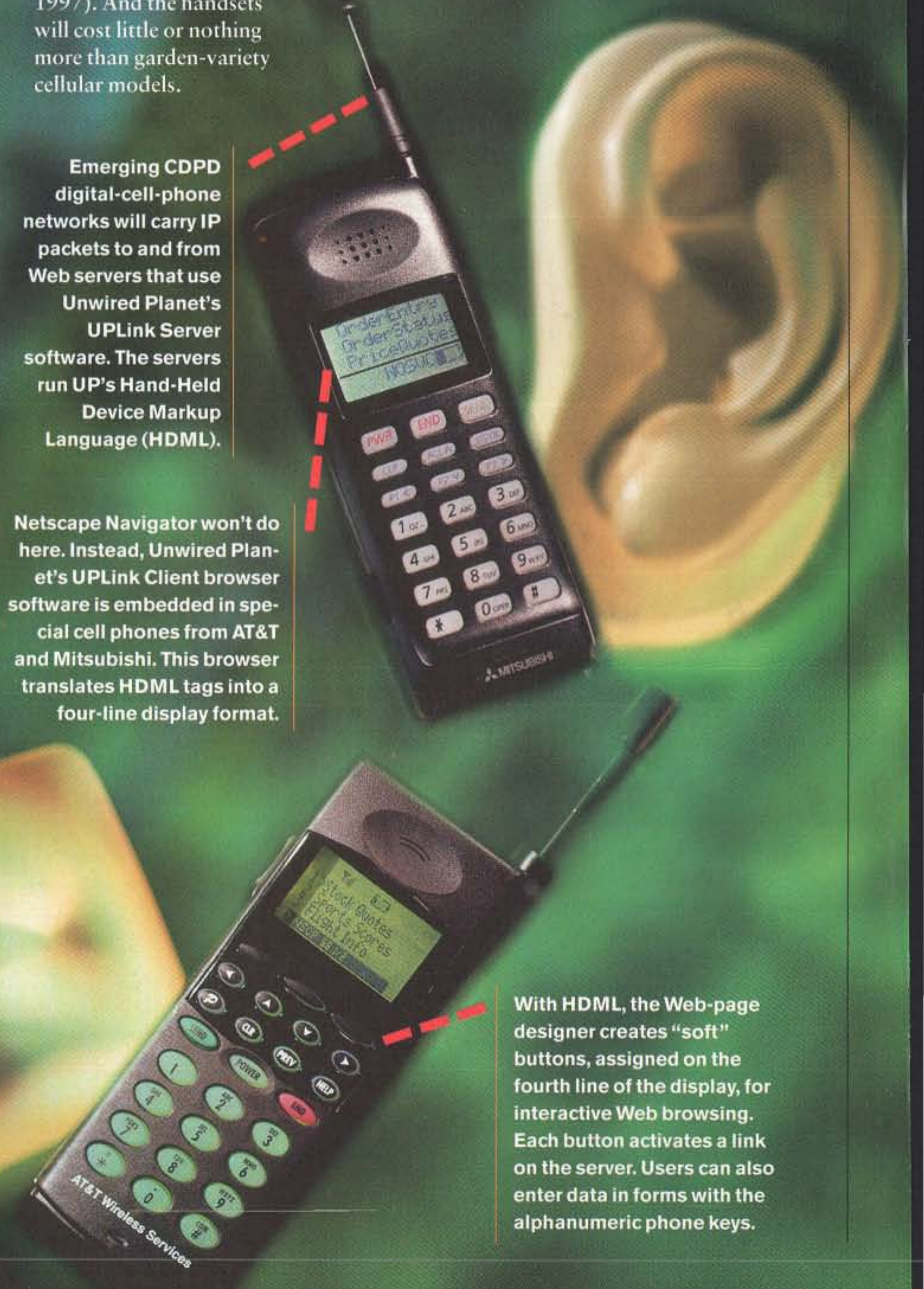
(415) 596-5200
http://www
.uplanet.com

Internet Phone
(code name)
AT&T Wireless Services
Wireless Data Division
Kirkland, WA
(800) 552-3373
http://www
.airdata.com

Web Phones

How universal is the Web? With the arrival of a new generation of digital cell phones, it will be just a phone call away. You can book a flight, check on a package, get a stock quote, or phone in a sales order to any public or intranet server attached to AT&T's Cellular Digital Packet Data (CDPD) wireless Internet-access service (which will be fully commercial in early 1997). And the handsets will cost little or nothing more than garden-variety cellular models.



Emerging CDPD digital-cell-phone networks will carry IP packets to and from Web servers that use Unwired Planet's UPLink Server software. The servers run UP's Hand-Held Device Markup Language (HDML).

Netscape Navigator won't do here. Instead, Unwired Planet's UPLink Client browser software is embedded in special cell phones from AT&T and Mitsubishi. This browser translates HDML tags into a four-line display format.

With HDML, the Web-page designer creates "soft" buttons, assigned on the fourth line of the display, for interactive Web browsing. Each button activates a link on the server. Users can also enter data in forms with the alphanumeric phone keys.

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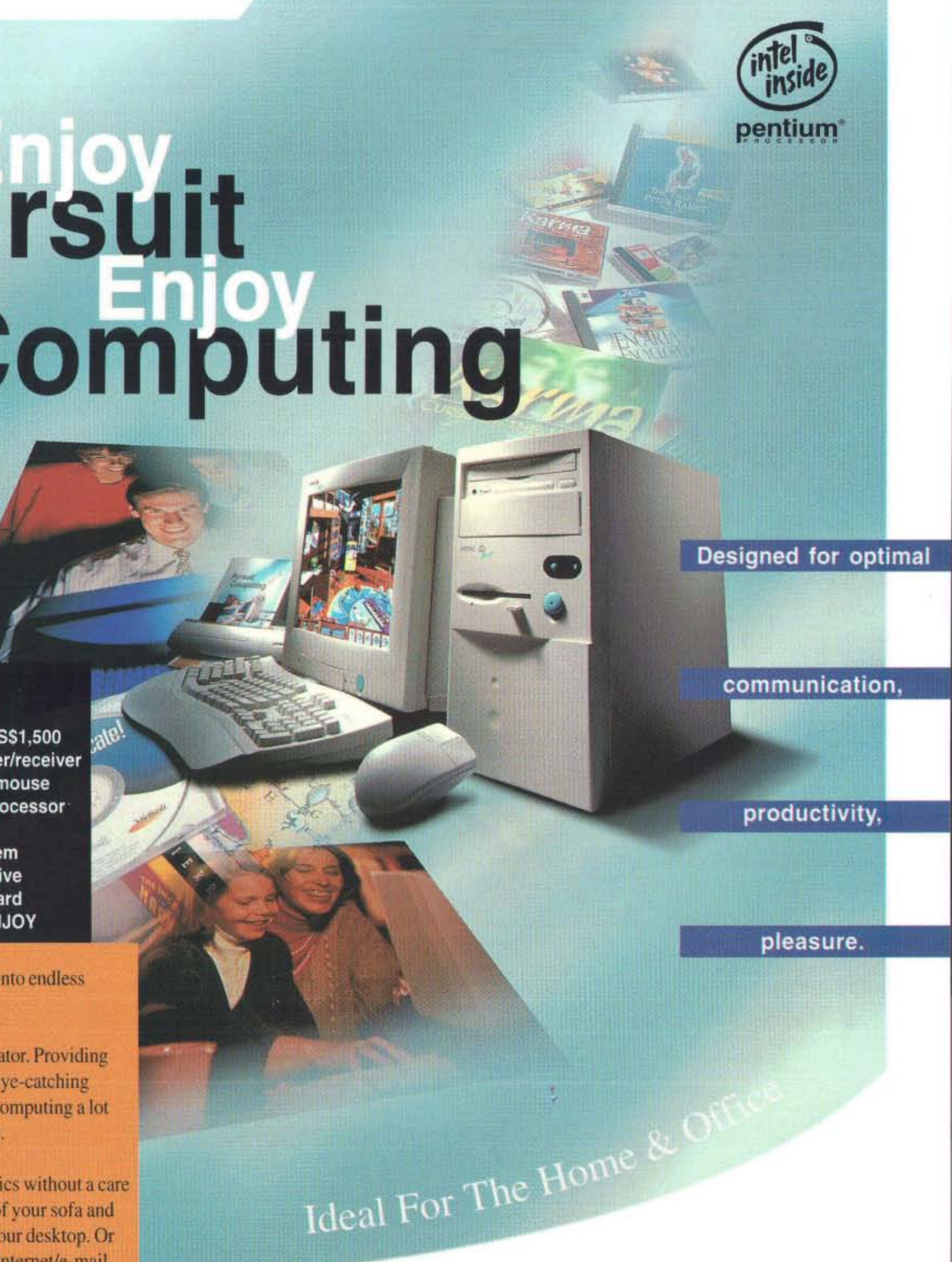

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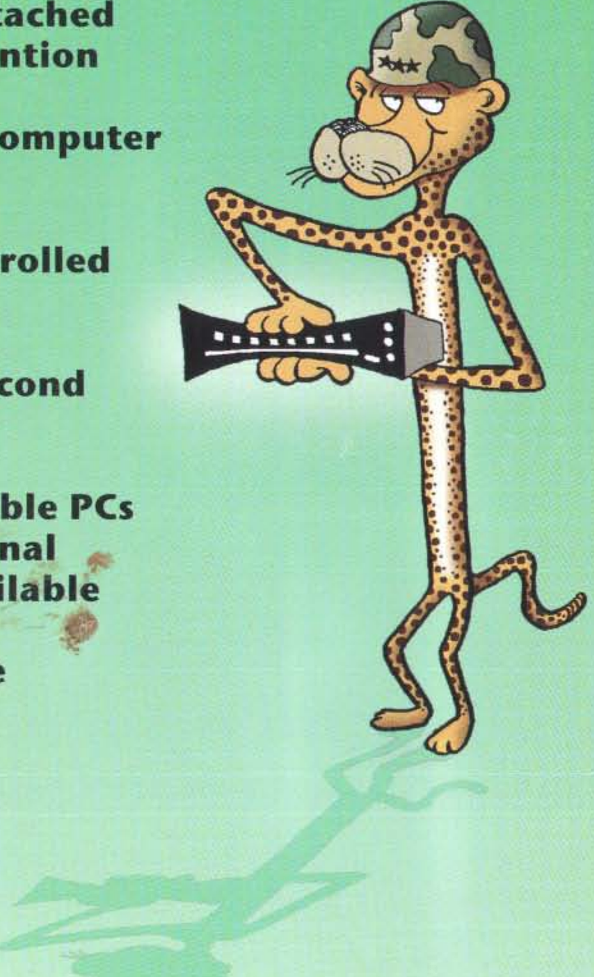

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Dealer Program Available

Circle 704 on Inquiry Card (RESELLERS: 705).

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